National Institutes of Health (U.S.) Office of the Director

DR. THOMAS J. KENNEDY, JR.'S

SPEECHES AND ARTICLES

SPEECHES AND ARTICLES BY DR. THOMAS J. KENNEDY, JR.

DATE	PLACE	TITLE	See TAB
4/24/69	Galveston, Texas	"The outlook for careers in biomedical research." Presented at the 1969 SAMA-UTB National Student Research Forum.	1
2/6/70 PUBLISHED	Chicago, Ill.	"National expenditures for biomedical research." Co-authored by Drs. Robert W. Berliner & Dr. Thomas J. Kennedy, Jr. Published in the Journal of Medical Education, Vol. 45, Sept. 1970.	2
2/25/71	"Linden Hill"	Chart presentation before the AD HOC Advisory Group on Simulation Models.	3
5/14/71	NSF	"Academic science support programs of the NIH." Presented before the Advisory Committee for Planning, NSF.	4
5/20/71	NIH	Dedication of the Primate Building.	5
12/9/71	N.Y.	"Comments on the paper of Dr. Ivan L. Bennett entitled 'support of research and graduate education in the United States.'" Delivered in the seminars on science and public policy at Rockefeller University.	6
2/11/72 PUBLISHED		"Factors contributing to current distress in the academic community." Co-authored by Drs. Kennedy, Sherman, & Lamont-Havers. Article published in Science, Vol. 175, Feb. 11, 1972.	7
2/29/72	NIH	"Basis for determining resource allocation for biomedical research." Delivered at NIH orientation for HEW management interns.	8
2/22/73	NIH	Chart presentation before the Director's Advisory Committee (new council members).	9
3/29/73	Wash., D.C.	"NIH research program-project and center grants." Presented before the Amer. Assoc. of Med. Colleges (AAMC).	10

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DATE	PLACE	TITLE	See TAB
6/4/73	NIH	Untitled speech. Given as a keynote address for the program planning session sponsored by the STEP Committee, NIH. Topic: Staff training for extramural programs.	11
6/15/73	Manhattan, Kansas	"Prospects for federal support of biomedical research." Prepared for delivery before the Society of Developmental Biology, Inc.	12
6/26/73	NIH	Chart presentation before the DAC.	13
12/3-4/73	NIH	"An experimental alternative to program project and center grants." Presented at the Director's Advisory Committee (DAC) meeting.	14
1/29/74		Slide presentation. Delivered at the Inter-council meeting.	15

-----------------------------Given-as-an-official-of-the-AAMC-------------

DATE	PLACE	TITLE	See TAB
3/31/75		"Status of funding of NIH/NIMH sponsored research." Presented before the spring meeting of the Council of Academic Societies, Assoc. of American Med. Colleges (AAMC).	16

TAB 1

THE OUTLOOK FOR CAREERS IN BIOMEDICAL RESEARCH*

By

Thomas J. Kennedy, Jr., M.D.**

Dr. Blocker, Mr. Ferguson, Ladies and Gentlemen:

I am honored by your invitation to address this meeting and only hope that the subject matter I have chosen will strike a responsive chord. In considering various possible themes, I reflected that this meeting would be peopled by young men and women either beginning a career in medical research or nibbling at this activity as a career alternative. Each of you has arrived at your present outlook through some magical combination of internal drives--for more knowledge, better understanding, less uncertainty--and external inspiration. The challenge of the unknown has in some measure formed your attitudes and aspirations. And you have undoubtedly been influenced by your educational environment, whose standards of excellence and scholarship have also molded your thinking and your ambitions. I have no credentials that permit me to speak with authority in these areas. I would propose, instead, to explore the purely administrative dimensions of the human activity called research, mentioning some of their implications for the investigator.

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*Presented at the 1969 SAMA-UTB National Student Research Forum, Galveston, Texas, April 24, 1969.

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My first thesis is that research in general, and biomedical research in particular, are to a very significant extent an activity of the public and not the private sector. Slide 1 depicts schematically the growth of the Nation's research and development since 1950. At that time the estimate of expenditures for all R&D in the United States was \$2.9 billion, of which \$161 million, or about 5 percent, was allocated to biological and medical research activities. By 1968 the comparable estimate for all R&D was \$25 billion, of which about \$2.5 billion, or 10 percent, went for biomedical R&D.

Slide 2 represents our country's growing investment in R&D over the last two decades, and indicates the shift in emphasis to the problems of biology and medicine during the last decade. We see that the Nation's investment in research is substantial, both in absolute terms and in relation to our gross national product--currently about \$900 billion per annum.

Slide 3 outlines the rate of growth in the contribution of several sectors to the total national investment in biomedical research. Several points emerge clearly. The Federal Government has assumed the pre-eminent role as patron of biomedical research, reaching parity with the nonfederal sector in the 1950's and eclipsing it in the 1960's. Industrial investments have also grown rapidly.

Slide 4, in which comparable data are presented in tabular form, shows that Federal sources have steadily increased, both absolutely--

from \$27 million in 1947 to \$1.6 billion in 1968--and relatively--from 31 percent of our total national investment in 1947 to 64 percent in 1968.

Slide 5 shows in somewhat greater detail the contribution of the several sources of funds at various points in the time series. It emphasizes the relatively slow growth of contributions from the nonindustrial private sector.

Slide 6 is a graphic representation of where the research money comes from and where it is consumed. It is important to note that the funds contributed by industry are expended almost exclusively in industrial laboratories. Funds contributed to the national effort by the Federal Government are expended in Federal laboratories such as those of the National Institutes of Health at Bethesda; in academic institutions; in research institutes, hospitals, and State and local health departments; and to a limited extent, in the laboratories of industry.

Slide 7 outlines the contributions of the Federal agencies most heavily engaged in the support of biomedical science. The Department of Health, Education, and Welfare is by all odds the most significant of the Federal agencies, having steadily consolidated its position of preeminence. You will note that one component of the Department, the National Institutes of Health, is responsible for the lion's share of the DHEW activities in this field. As compared with DHEW, Federal

agencies such as DoD, AEC and NASA, which account for 85 percent of all Federal R&D expenditures, contribute only modestly to biomedical research.

This series of slides, then, presents data in support of my first thesis--to wit, that biomedical research is a function of the public, not the private sector. A corollary is that one who aspires to a career in science, and especially in biomedical science, will be heavily and inescapably dependent upon public policy decisions.

My second thesis is that it behooves the investigator to know something about the nature and the functions of the public institutions that will exert such a profound influence over his career. For purposes of this discussion a general description of the National Institutes of Health will serve as an introduction to agencies in the Executive Branch of Government, and on this I can speak from considerable experience. Since the Executive proposes but the Congress disposes, a rounded survey also calls for a look at the legislative processes.

The modern history of the National Institutes of Health begins with the end of World War II, when the agency was assigned responsibility for biomedical research contracts between the wartime Office of Scientific Research and Development and public and private research organizations. Slide 8 shows the pattern of NIH growth as well as the types of support it provides. The bulk of its funds have supported

research projects, either conducted directly on the Bethesda campus or through research grants to investigators throughout the country. Training grants to develop human resources for research have been awarded since the late 1940's, and grants for the construction of physical facilities, since 1957.

<u>Slide 9/</u> derived from appropriation data also indicates the categories of scientific problems which have commanded attention through these diverse mechanisms. The first tier represents the National Institutes of Health that have come into being since 1937 through legislative enactments--the National Cancer Institute, National Heart Institute, etc. DBS stands for the Division of Biologics Standards, which conducts a research and regulatory function dating from 1902. The Institutes' names and the magnitude of the Congressional appropriations for their activities reflect the nature and extent of public concern for major classes of disease. It is the task of the Federal bureaucrat to devise the machinery for translating such mandates into scientifically sound programs.

<u>Slide 10</u> illustrates how this works out in practice, using a single Institute as an example. Of the billion-odd dollars appropriated to the NIH in fiscal year 1967, $164 million was earmarked by the Congress for the National Heart Institute. $127 million of this amount was spent for research (<u>vis à vis</u> training, general support and other nonresearch activities). The research actually funded can be broadly classified as related to atherosclerosis, hypertension, other vascular diseases etc./ Further subclassification of atherosclerosis and hypertension into etiology, diagnosis and therapy are possible, as shown.

vascular diseases.

Slide 11 gives a comparable breakdown of the expenditures of the National Cancer Institute. Obviously each segment of each pie chart could be exploded into finer and finer subdivisions. Thus we see how funds appropriated by Congress for broad missions like the control of cancer ~~are~~ can be programmed into research efforts addressed to objectives readily recognizabl by scientists as research opportunities.

As a slight digression, you might be interested in the process whereby a research grant is awarded. Slide 12 illustrates that the process begins in the imagination of the investigator. He submits an application, through his institution, to a division of NIH--the Division of Research Grants--whose major function is to provide an objective scientific evaluation of the proposal. The applications that survive the process--about 55 percent--are then referred to the appropriate National Institutes for examination of their relevance to the Institutes' missions.

Clearly the universe of medical research is far broader than the ten categories included in the names of the ten National Institutes. Clearly also, it is not within the realm of the practical or feasible to have a National Institute for each disease to which man is prone or for each organ of the body. Over the years, the domain of each Institute has been broadened by arbitrary assignment of responsibility for programs not clearly inherent in its title.

It is important to note that responsibility for each decision on scientific merit and program relevance is in the hands of advisory groups--study sections and National Advisory Councils--composed of non-Government people. The process is one which those of you who remain in research will become quite familiar with, both as applicants and later as members of advisory bodies.

For some time it has been evident that the viability of a national research effort depended on support for more than the traditional research projects. Slide 13 indicates the types of support mechanisms that have developed in recent times, together with a rough measure of the funding for each.

Special resource awards, for instance--mainly to centers devoted to primate biology, clinical research, computation and data processing--have been established. Large umbrella awards called program projects, which fund under one instrument a series of coherent activities, have been created. In instances where the Government is able to specify exactly what it expects, as in the case of technical development efforts, research contracts permitting virtually no freedom of movement to the investigator have come into use.

To sustain, renew and expand the research effort, training grants to institutions and fellowship awards to individuals on a nationally competitive basis have emerged as important components of the Institutes' programs. Finally, the need for nonhuman resources--bricks and mortar--

is met through programs for the construction of educational and research facilities. Again, many of you will soon be personally involved in NIH-supported fellowship and training grant programs.

Let me move now to a rather crucial question. How does NIH get the money to disperse through this array of mechanisms? Slide 14 is a map of the budgeting process whereby NIH begins in the spring of each year and ends some 18 to 21 months later with money in hand. The route is tortuous, and for today's purposes we need only give it the most general treatment.

The first part of the cycle, taking approximately one year, represents a battle to get the right words into the President's annual budget message to the Congress. The proceedings are, I think, basically adversary. Each Institute devotes its energies to the realization of a budget that most closely approximates its estimate of the needs and opportunities in its domain of responsibility and authority.

Arrayed against the importunings of the Institutes stand the President's organizations for fisal matters--the Council of Economic Advisors, the Bureau of the Budget, the Treasury, the Internal Revenue Service. Their staffs must assess the state of the national economy, the economic and political feasibility of taxation schemes, the probable revenue available to the Government. They must lay before the President the consequences of various total levels of expenditure and various degrees of balance or imbalance of the budget. Finally, they

must reconcile--within the decided total level of national expenditures--the competing claims of all the Federal agencies.

The process then entails upward justification of the initial proposals against ceilings set by higher authority. The NIH Director must reconcile the competing claims of the Institutes; the Assistant Secretary for Health and Scientific Affairs, the competing claims of research, environmental health, and health services; and the Secretary, the competing claims of the health, education, and welfare sectors. The outline before you idealizes the process. In point of fact, it is replete with all sorts of epicycles and feed-back loops, with less and less time available for decisions as the deadline for the printing of the President's Budget nears.

In January of each year, the dialogue within the Executive Branch ceases with the submission to the Congress of the President's Budget for the fiscal year to begin on the coming July 1. During the spring, the cognate Congressional appropriations subcommittees hold hearings in which the responsible officials of the Executive agencies are called upon to defend and justify the President's requests. Recommendations of these subcommittees, as modified and approved by the full Appropriations Committee, are then debated, amended, and eventually submitted to vote for the approval of the House and the Senate. When the two appropriations bills differ substantially, differences must be reconciled by a Conference Committee made up of members from each body, and then the Conference Bill is resubmitted to both houses.

During the hearing process, interested citizens have been permitted to submit their views for the record, either in person or in writing. In this way the Congress gets some sense of the breadth, depth and weight of public interest.

Slide 15 from the Congressional Record reflects a little-recognized fact of life. If one assumes, particularly at a time like the present, that the funds for National Defense are relative irreducible, 80 percent of the $200 billion Federal budget is fixed and mandatory. All the domestic programs, including those in health research and health professions education, must come out of the remaining 20 percent.

more text needed

Slide 16 depicts the controllable and noncontrollable items in the budget of DHEW, and reveals the disturbing fact that only $7 billion, or 12 percent of a total budget of almost $60 billion can be viewed as controllable.

The significance of these facts lies in the effects of an unforseen contingency. Two broad types of contingency may arise: overestimation of revenues, and underestimation of mandatory commitments. The task of predicting what the national tax and other revenue receipts will be, say in November or December of 1968 for the fiscal year ending on June 30, 1970, is never less than formidable. Nor is the task of estimating mandatory costs a simple one. Many Federal obligations are open-ended--for example, those committed to the reimbursement of individuals who have made predetermined contributions.

The point I wish to press here is that errors in forecasting must be referred to the controllable and not to the total budget. Moreover, a $10 billion deficit over anticipated assets--well within recent precedents, by the way--may represent only a 5 percent error when referred to the $200 billion budget, but will actually entail a 25 percent reduction in controllable expenditures, to maintain the degree of balance deemed advisable by the President.

My third thesis is that in a fiscal crunch, research is among the most vulnerable items in the Federal Budget. To many, research is the open sesame to the solution of a whole gamut of human problems. It is seen as the one and only hope to reduce the human and social costs. And this is particularly true in the field of health. For example, neoplastic disease takes a tremendous toll in human lives as as result of our inability to cope with the neoplastic process. In addition, the social costs--in losses to the labor force, in medical and hospital expenses, in welfare payments to dependents, etc.--are enourmous. Most of us share the belief that the situation is not likely to improve unless scientific efforts are successful in creating new knowledge and fresh insights.

Unfortunately, this view has not permeated broadly and deeply into the fabric of our national thinking. As a consequence, Federal officials must provide an annual accounting for expenditures, and tend to operate in a context in which there are implicitly required, if not

explicitly demanded, expectations for annually reportable, major scientific breakthroughs. In part, this circumstance reflects a misunderstanding of the processes of scientific research; in part, a measure of the fierce competition for resources in contemporary society.

Even the scientist may find it useful now and then to pause and contemplate the secular course of activities in which he partakes. Slide 17, illustrating such a digression, is adapted from a study supported by the National Science Foundation and conducted by the Illinois Institute of Technology Research Institute. The study is entitled "Technology in Retrospect and Critical Events in Science"--acronym, TRACES. It has traced here the critical events in science and technology which culminated in the introduction of the electron microscope. If much of the detail in this and the next slide is illegible, the points I wish to emphasize do not depend on this detail.

Note that the important technological achievement represented here has roots traceable to about 1860. It depended on the convergence of a number of major lines of research and development: on the wave nature of light; the wave nature of electrons; electron sources; electron optics; and cathode-ray tube development. We see that "technical development and application" (symbolized by the green squares) is a very late phase in the process, and that "mission-oriented research--signifying effort focussed on a practical goal in contrast to new knowledge for its own sake--(symbolized in the blue triangles) is usually preceded by a long history of basic investigation.

Technological improvement, too, is likely to depend on fruition of a long chain of events in pure and mission-oriented research. For example, the development of cryogenic lens systems for electron microscopy became possible only with extensive advances in low-temperature physics.

Slide 18 depicts the history of events in steroid chemistry and hormone research and in the physiology of reproduction which culminated, at the beginning of this decade, in the oral contraceptive. Once again we see free-ranging non-mission research, followed by mission-oriented research, and finally by technical development and application.

In this case, recycling can be observed. For example, in the early 1930's, hormone research by a number of distinguished scientists had reached the stage at which applicability was obvious, and the manufacture of hormones from animal sources for therapeutic use began. The availability of synthetic sex hormones in the early 1960's, made possible by four decades of progress in steroid chemistry, stimulated and facilitated a great deal of mission-oriented research. Finally, these lines of inquiry converged in the 1950's on the problem of contraception and culminated in the introduction of the "pill," a major milestone in the history of contraceptive technology.

The last two charts suggest some of the difficulties in defending science budgets. It is fairly easy, looking through the retrospectoscope in 1969, to select that small portion of information published in 1930

which proved critical for the subsequent discoveries. But one may wonder what practical value could honestly have been foreseen for these findings in 1930. One may also speculate on whether in, say, 1980, with the advent of some presently unforseeable achievement, we will attach signal importance to information which does not now seem critical for subsequent major developments.

The scientist recognizes from his sense of history that some emerging bit of new knowledge, even though unidentifiable now, will in all likelihood form an essential link in the chain of events leading to important achievements. But the justification of public expenditures for research will be difficult until a far larger segment of the public understands this process of cumulative growth of scientific information and appreciates the difficulties of assessing isolated contemporary increments in knowledge. [Lights please]

The annual agonizing reappraisal of research budgets reflects not only the difficulties encountered in perceiving causal relation between recent investments and major returns, but also the fact that many competing claims for research dollars to solve a vast array of problems are heard throughout the land. No one has outlined the alternatives facing the Nation more eloquently than Mr. William Carey, erstwhile Assistant Director of the Bureau of the Budget. He asks:

> What are we going to do with (R&D)? Inspect the outer universe or the inner city? Discover new atomic particles or new routes to human understanding? Build better

> accelerators or better neighborhoods? Probe the deep oceans or the causes of violence? Spend much on learning to prolong life and almost nothing on learning to use life? Shall we do all these things, or other things, or none of them?

In the last few years, the most pressing preoccupation of the bureaucracy is how to order its priorities for investment among the competing claimants. The search for methodology, for a logical value system for ordering these priorities, and for optimizing the investment of public funds preempts the time and energies of some of our most dedicated public servants. It turns out that there is probably no calculus devisable to resolve these issues in black-and-white scientific terms. The problems are basically political, and solutions must be sought through the political processes which have evolved for our governance as a society.

We may now be at the point at which my meandering explorations of the administrative context for medical research become relevant to your aspirations for careers in investigation. For by now it must be plain that the funding of such a career will be intertwined with the public policy decisions of the Federal Government.

If career opportunities are to be provided in numbers commensurate with the challenges before us, the Executive and Legislative arms of the Government must consciously and deliberately make certain choices and long-term commitments. People with a large stake in these decisions can hardly evade responsibility for them or avoid direct and personal

involvement. The critical role of science in human affairs demands that the scientist take an active part in creating the climate of public opinion which will facilitate--yes, even force--the public policy decisions for continued investments in research.

In making this assertion, I am aware of the paradox that a career reputed to attract those more interested in "things" than in "people" is vitally dependent upon the ability of the research worker to persuade the average citizen of the importance of this pursuit.

The scientific performance requirements for careers in biomedical research are in general known to most of you. As yet, little thought has been given to the additional nonscientific requirements imposed on the scientist in the last third of the 20th Century as a consequence of the Federal Government's emergence as the principal patron of science. I am no authority on these matters, but would like to offer a few random thoughts on the relationship between scientist and citizen.

The scientist's message to the public must clearly articulate all the values of research. The value most immediately apparent is, of course, the promise that research holds for the practicing physician. Research is the key to progress. Further, the research process is extremely valuable in and of itself. For research is the method for graduate education in the sciences, and mastery of its techniques and viewpoint prepares the practitioner for the problem-solving exercises that characterize his occupation. Every physician can profit from an exposure to research in depth--from the experience of formulating a

problem, working out an experimental design, accumulating data, evaluating results, recycling through the process to refine the formulation or the design, drawing conclusions, defending them through a review process, and publishing. Finally, research is the refinery for new teachers in our academic institutions, the fountainhead of replacement and renewal for retiring faculty, and the nuclei about which new schools are formed.

As to the audience for the message of the scientist, the ultimate decision makers are the President of the United States and the members of the Congress. A number of scientists have functioned quite effectively in informing, educating and persuading key public officials at the highest level of government. They have accomplished this through person-to-person contacts, through representation of local constituencies and national organizations, through representation before Congressional committees, and so forth. Most legislators welcome expert advice, particularly when it comes from within their own communities. Its persuasiveness is directly proportional to the cogency of the argument, the stature of the advocate, and the public good at stake.

The highest level of government is not the only arena in which the scientist can be publicly effective. Both the Executive and the Legislative Branches are profoundly concerned with another issue--the grass roots support accorded their decisions. This approach to broad citizen understanding and empathy has perhaps been less traveled than

the routes to Washington, D.C. Yet it is precisely at the local level that constituencies could be built, that systematic efforts to inform and educate could be undertaken, and that attempts to associate citizens with the grand undertakings and aspirations of research could yield large returns.

To this end the investigator can address high school students, citizens' associations, PTA's, Kiwanis clubs, the League of Women Voters, etc. Research laboratories could hold "open house," to exhibit their work to the community and to make the ultimate supporter of the enterprise--the taxpayer--feel a part of it. Finally, patients could be encouraged to learn about research activities and, in the case of those admitted to clinical research centers, be made aware that public funds were conducive to whatever benefit may have accrued. The steady, systematic cultivation of public understanding cannot fail to yield dividends in the form of stable and growing public support.

Positive and constructive advocacy of research should recognize that as a human activity, it must compete in a market with other attractive pursuits. Two threats are clearly discernible: research seems to be losing its appeal; and other activities, principally health services, are commanding an increasing measure of public attention.

Why does research appear to be in eclipse? One reason is that it has become a large enough activity to be a prominent target, to

have committed errors, and to have acquired some enemies. In short, it has incurred a substantial degree of hostility.

The social critic finds it a suitable target for the sly dig. Jacques Barzun, Provost of Columbia, follows his distinguished book on "The House of the Intellect" by one entitled "Science: The Glorious Entertainment." Daniel Greenberg opens an impressive enquiry into the relationship between science and the United States Government with a hierarchical description of the so-called Scientific Establishment. Just last month, Spencer Klaw published a book with the clever title "The New Brahmins: Scientific Life in America." Such descriptions both reflect and foster the growing disenchantment with science and scientists.

Research is also taking its lumps from students, some of whom see it as separating them from their teachers and contributing to the irrelevance of their education. Certainly, students have a legitimate complaint if they are inadequately taught and their curriculum is irrelevant. In my view students deserve nothing less than a well-taught, relevant curriculum--a product unattainable outside an environment enriched by bold scientific inquiry.

Perhaps even more strident in their derrogation of research are the action-oriented individuals both within and outside the health professions. Faced with an overwhelming backlog of unmet need for

health services, these people view research as a lure to divert people and funds from the real and urgent social problems of our times.

Again, I would argue that as a nation we can and must support both research and service. Furthermore, a career in research is no less noble a vocation than one committed to service. The $2.5 billion annual outlay for research and development is small compared with our total national health expenditures of more than $55 billion, and even the complete abolition of all research activity would only increase the funds available for service by 5 percent.

I perceive a certain irony in the fact that some of those most deeply committed to stamping out disease seem prone to overlook the enormous mass of disease which no amount of presently available money or intelligence could modify. And here, perhaps, lies the root of the growing disenchantment with research. In the last couple of centuries, but particularly in the last few decades, science has been successful to an absolutely incredible degree, and as a consequence has revolutionized human existence. Dr. Lee DuBridge, appointed by President Nixon to direct the Office of Science and Technology, recently commented on this phenomenon in testimony before the Subcommittee on Science Research and Development of the House Committee on Science and Astronautics:

> Our success in the search for knowledge and in applying it [he said] has far exceeded the wildest dreams of our fathers and mothers. But we want more--much more. We can conquer

> some diseases; why not all? We can fly to Europe in a few hours; why can't we get to the airport more quickly? The world could grow many times as much food as it needs; why is there still hunger? We have built a vast educational system that most of the world envies; why can't we make it still better adapted to match our new needs and our new ideals.

This description suggests that we have conditioned ourselves, as a people, to expectations that increase not linearly but exponentially. And by the same token, we have rendered ourselves highly susceptible to frustration and disenchantment. The National Cancer Institute, since 1938, has indeed spent nearly $2 billion for research and research resources. But cancer--and for that matter, atherosclerosis, aging, and schizophrenia--remain formidable and terrifying medical problems. In the light of the dearth of cures to date, what course is more likely to yield solutions to these problems: a decrease or increase in future investments?

I have tried to review for you who stand on or just over the threshold of careers in biomedical science some of the political, economic and social dimensions of the universe of research. In the United States today, research is predominantly a public rather than a private enterprise. Its rise and fall are therefore strongly dependent upon the processes and institutional forms of the Federal sector. Biomedical research is performed principally in Academe and is supported primarily by the National Institutes of Health to the extent permitted by the Department of Health, Education, and Welfare, the Bureau of the Budget, the President, and the Congress of the United States.

Biomedical research, like scientific research in general, has come upon hard times lately. It is less and less cherished, for a variety of reasons. But this only serves to emphasize the need for its devotees to cultivate understanding, respect and support. Surely, this is a noble and worthy effort, for in the pursuit of knowledge resides man's best and only hope to move forward to a significantly higher plane of health and well-being--conditions requisite to the fullest expression and deepest realization of his freedom, his dignity, and his humanity.

FOR THE RECORD:

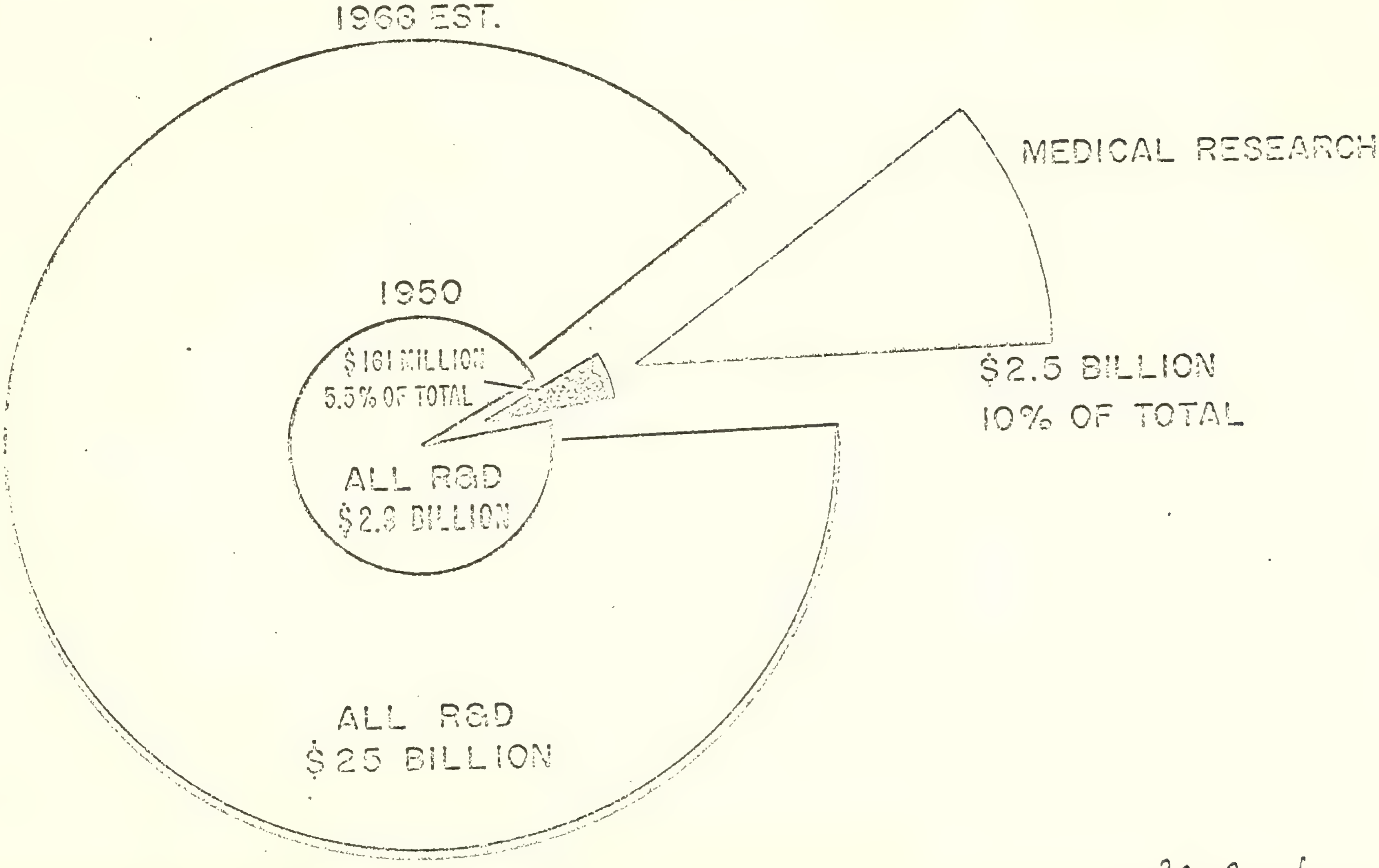
Dr. Thomas J. Kennedy gave a speech entitled "The Outlook for Careers in Biomedical Research" at the 1969 SAMA-UTB National Student Research Forum on April 24, 1969 in Galveston, Texas. The following slides were used:

Slide Order	Title
1	Medical Research as a Proportion of all Research and Development, 1968 Est.
2	U.S. Medical Research and Development as a Proportion of Total U.S. Research and Development, FY 50-68
3	Sources of Medical Research Funds, 49,54,59,64,69
4	Federal Medical Research as a Proportion of Total U.S. Medical Research, FY 47-68
5	National Support for Medical Research, 1948-1968
6	Funds Obligated for Medical and Health-Related Research, U.S.--1969 Est.
7	Federal Support for Medical Research, FY 48-68
8	NIH Growth and Functions, Consolidated Appropriations, FY 55-69
9	NIH Appropriations, FY 1969
10	Heart Disease, Fund Allocation, FY 67
11	Cancer, Fund Allocation, FY 67
12	How a Research Grant is Made
13	NIH Grants and Other Awards by Type of Award, FY 1968
14	NIH Budget Process
15	New Budget Authority, Fiscal 1969

Slide Order	Title
16	DHEW Budget Authority--FY 1970
17	The Electron Microscope
18	Development of the Oral Contraceptive

SEE ATTACHED.

MEDICAL RESEARCH AS A PROPORTION OF ALL RESEARCH AND DEVELOPMENT 1950–1968



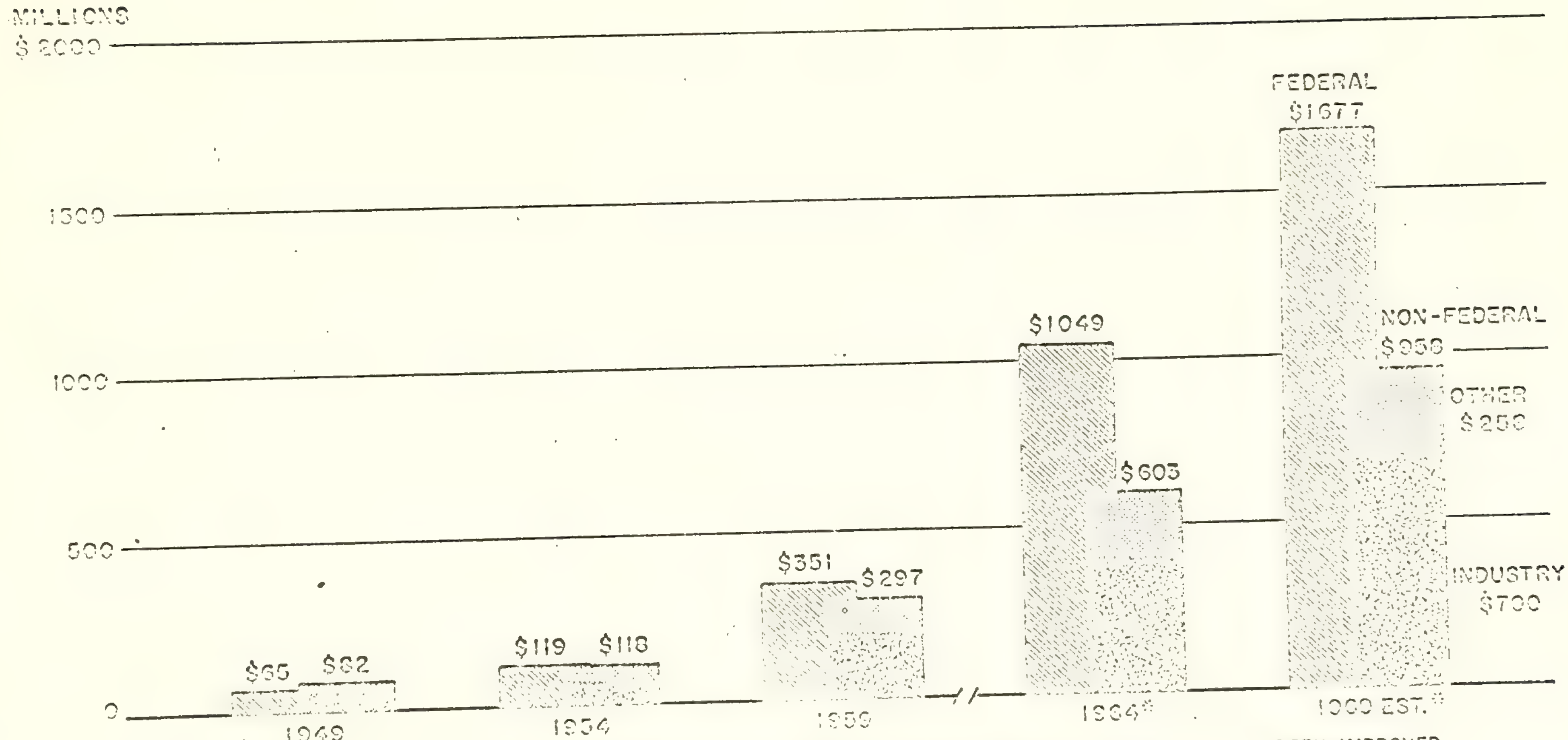
Slide 1

U.S. Medical Research and Development as a Proportion of Total U.S. Research and Development, Fiscal Years 1950–68

Fiscal year	Total U.S. research and development	U.S. medical research and development [1]	Medical research and development as a percent of total R. & D. (percent)
	Millions of dollars		
1950	2,900	161	5.6
1951	3,400	175	5.1
1952	3,800	197	5.2
1953	5,160	214	4.1
1954	5,660	237	4.2
1955	6,200	261	4.2
1956	8,370	312	3.7
1957	9,810	440	4.5
1958	10,810	543	5.0
1959	12,430	648	5.2
1960	13,620	845	6.2
1961	14,380	1,045	7.3
1962	15,610	1,290	8.3
1963	17,350	1,486	8.6
1964	19,180	1,652	8.6
1965	20,470	1,841	9.0
1966	22,220	2,057	9.3
1967 est.	23,800	2,280	9.6
1968 est.	25,000	2,490	10.0

[1] Excludes research training and construction.

SOURCES OF MEDICAL RESEARCH FUNDS
1949-1969



*NON-FEDERAL DATA ARE NOT STRICTLY COMPARABLE WITH THOSE FOR PRIOR YEARS, AS COVERAGE HAS BEEN IMPROVED.

Federal Medical Research as a Proportion of Total U.S. Medical Research, Fiscal Years 1947–68 [1]

Fiscal year	Total U.S. medical research	Total Federal medical research	Total non-Federal medical research	Federal as a percent of total U.S. medical research (percent)
	Millions of dollars			
1947........	87	27	60	31.0
1948........	124	50	74	40.3
1949........	147	65	82	44.2
1950........	161	73	88	45.3
1951........	175	85	90	48.6
1952........	197	103	94	52.3
1953........	214	107	107	50.0
1954........	237	119	118	50.2
1955........	261	139	122	53.3
1956........	312	162	150	51.9
1957........	440	229	211	52.0
1958........	543	279	264	51.4
1959........	648	351	297	54.2
1960........	845	448	397	53.0
1961........	1,045	574	471	54.9
1962........	1,290	782	508	60.6
1963........	1,486	919	567	61.8
1964........	1,652	1,049	603	63.5
1965........	1,841	1,174	667	63.8
1966........	2,057	1,316	741	64.0
1967........	2,280	1,458	822	63.9
1968........	2,490	1,601	889	64.3

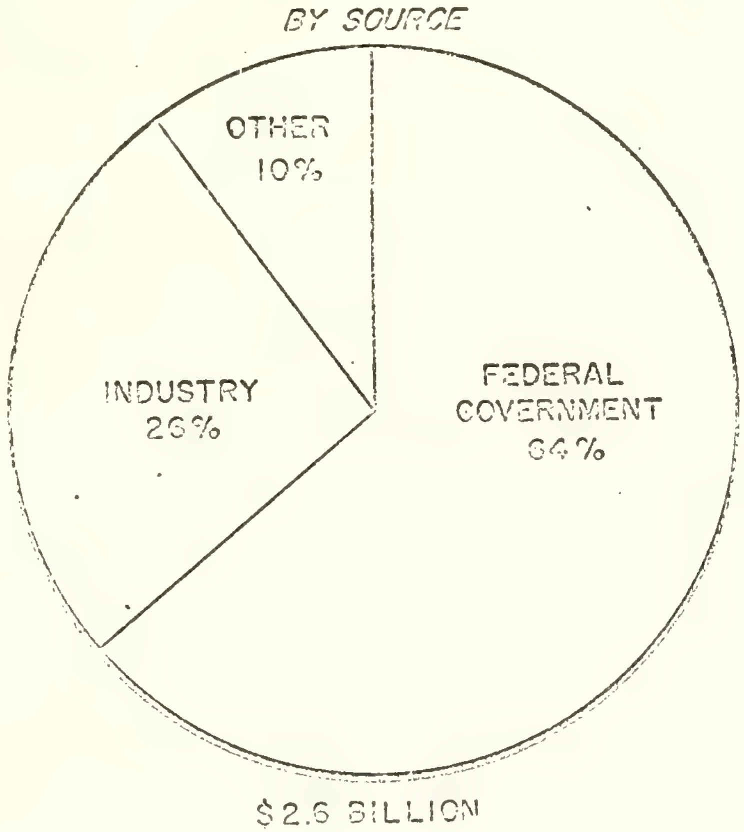
[1] Excludes expenditures for activities such as training or capital outlays for research facilities.

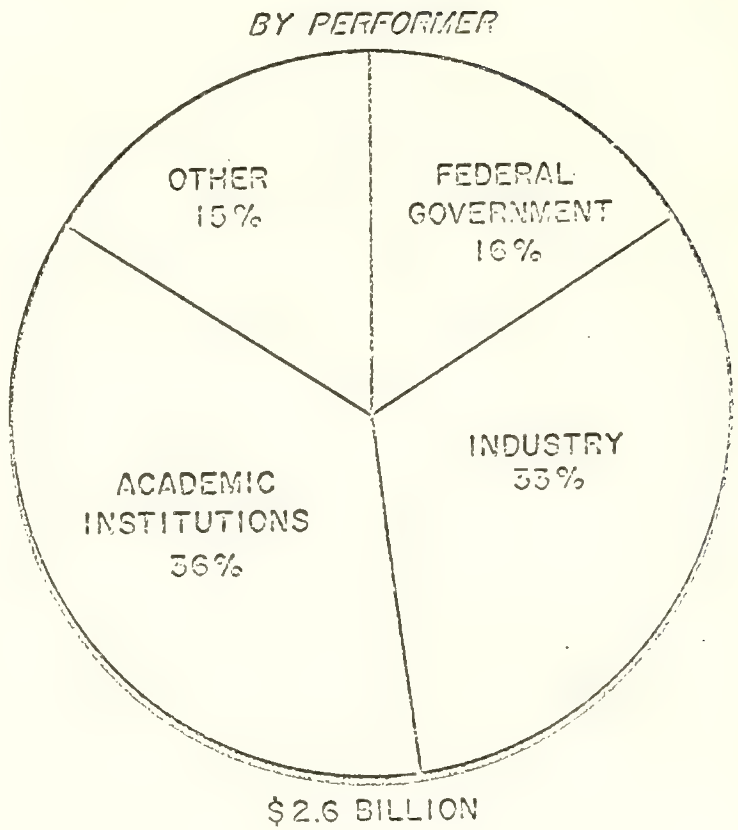
NATIONAL SUPPORT FOR MEDICAL RESEARCH, 1948–1968*
(Obligations in millions)

Source of funds	1948	1953	1958	1963	1964	1965	1966	1967 est.	1968 est.
Total	124	214	543	1,486	1,652	1,841	2,057	2,250	2,490
Government	50	108	292	964	1,099	1,229	1,377	1,523	1,670
Federal	50	107	279	919	1,049	1,174	1,316	1,458	1,601
State and local	n.a.	1	13	45	50	55	61	65	69
Industry	43	58	170	375	400	450	511	550	640
Private support	31	48	81	147	153	162	169	177	180
Foundations and health agencies	19	26	45	85	88	92	94	100	101
Other private contributors	n.a.	n.a.	6	21	22	25	28	29	30
Endowment	12	15	19	19	19	19	19	19	19
Institutions' own funds	n.a.	7	11	22	24	26	28	29	30

*Covers only medical and health-related research; such activities as research training and construction are not included.
Beginning with 1962, data for non-Federal components have been improved and are not strictly comparable with those for prior years

FUNDS OBLIGATED FOR MEDICAL AND HEALTH-RELATED RESEARCH
UNITED STATES - 1969 EST.





FEDERAL SUPPORT FOR MEDICAL RESEARCH, FY 1943–1969*

(Dollars in millions)

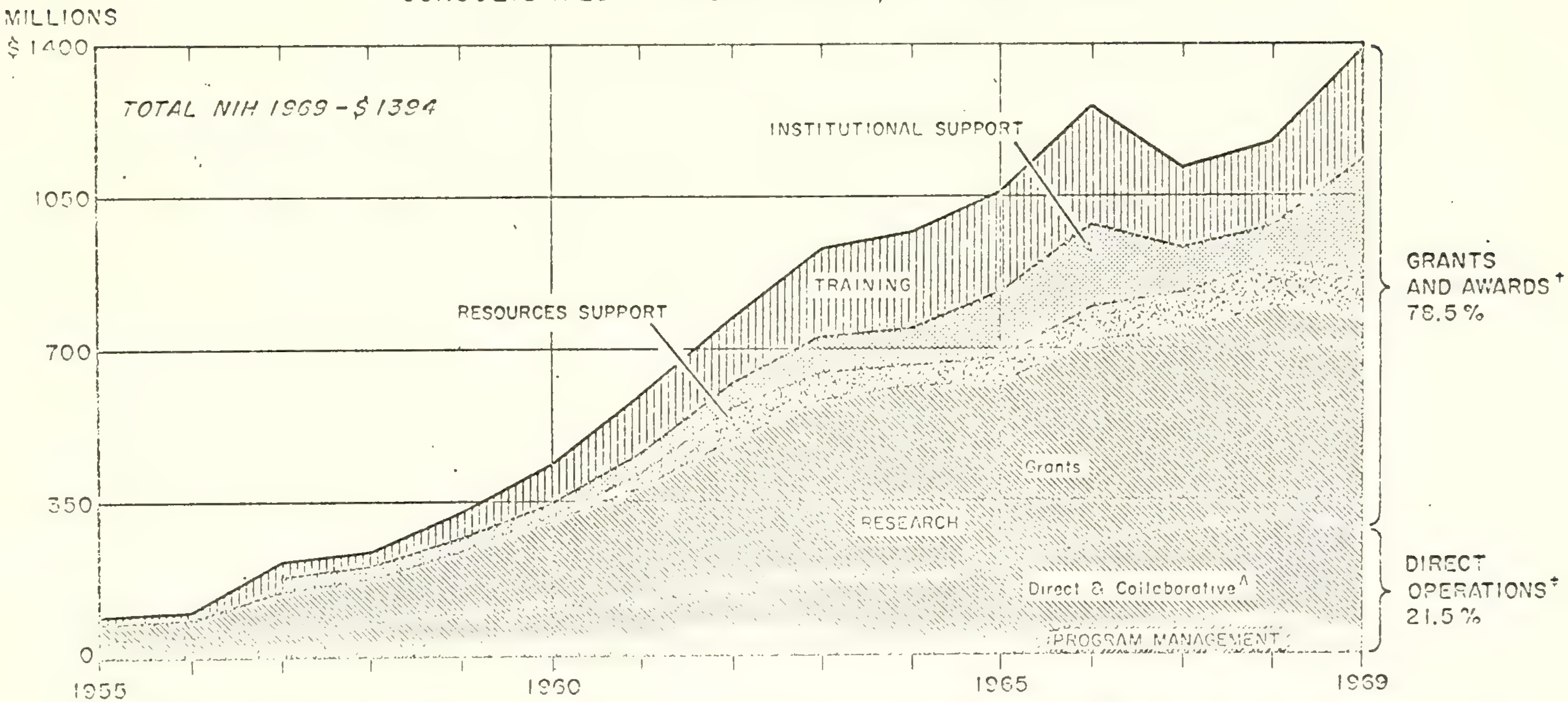
	1943		1953		1958		1963		1965		1966		1967		1969 est.	
	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent
Total	50	100.0	107	100.0	279	100.0	919	100.0	1,174	100.0	1,315	100.0	1,458	100.0	1,601	100.0
AEC	13	26.0	26	24.3	37	13.3	75	8.2	85	7.2	90	6.8	96	6.6	97	6.1
Agriculture	3	6.0	6	5.6	14	5.0	23	2.5	40	3.4	45	3.4	46	3.2	46	2.9
Defense	8	16.0	23	21.5	31	11.1	88	9.6	101	8.6	119	9.0	117	8.0	114	7.1
DHEW	22	44.0	47	43.9	183	65.6	642	69.9	826	70.4	925	70.3	1,050	72.0	1,165	72.8
NIH	(17)	(34.0)	(38)	(35.5)	(160)	(57.3)	(566)	(61.6)	(715)	(60.9)	(791)	(60.1)	(803)†	(55.1)	(873)†	(54.5)
FAA	–	–	–	–	–	–	3	0.3	3	0.3	3	0.2	2	0.1	3	0.2
NASA	–	–	–	–	–	–	34	3.7	60	5.1	75	5.7	82	5.6	108	6.7
NSF	–	–	–	–	4	1.4	21	2.3	20	1.7	14	1.1	14	1.0	13	0.8
VA	3	6.0	5	4.7	10	3.6	30	3.3	37	3.2	41	3.1	45	3.1	47	2.9
Other	1	2.0	–	–	–	–	3	0.3	2	0.2	4	0.3	6	0.4	7	0.4

*Covers only medical and health-related research, such activities as research training and construction are not included

†Excludes National Institute of Mental Health and includes Division of Environmental Health Sciences.

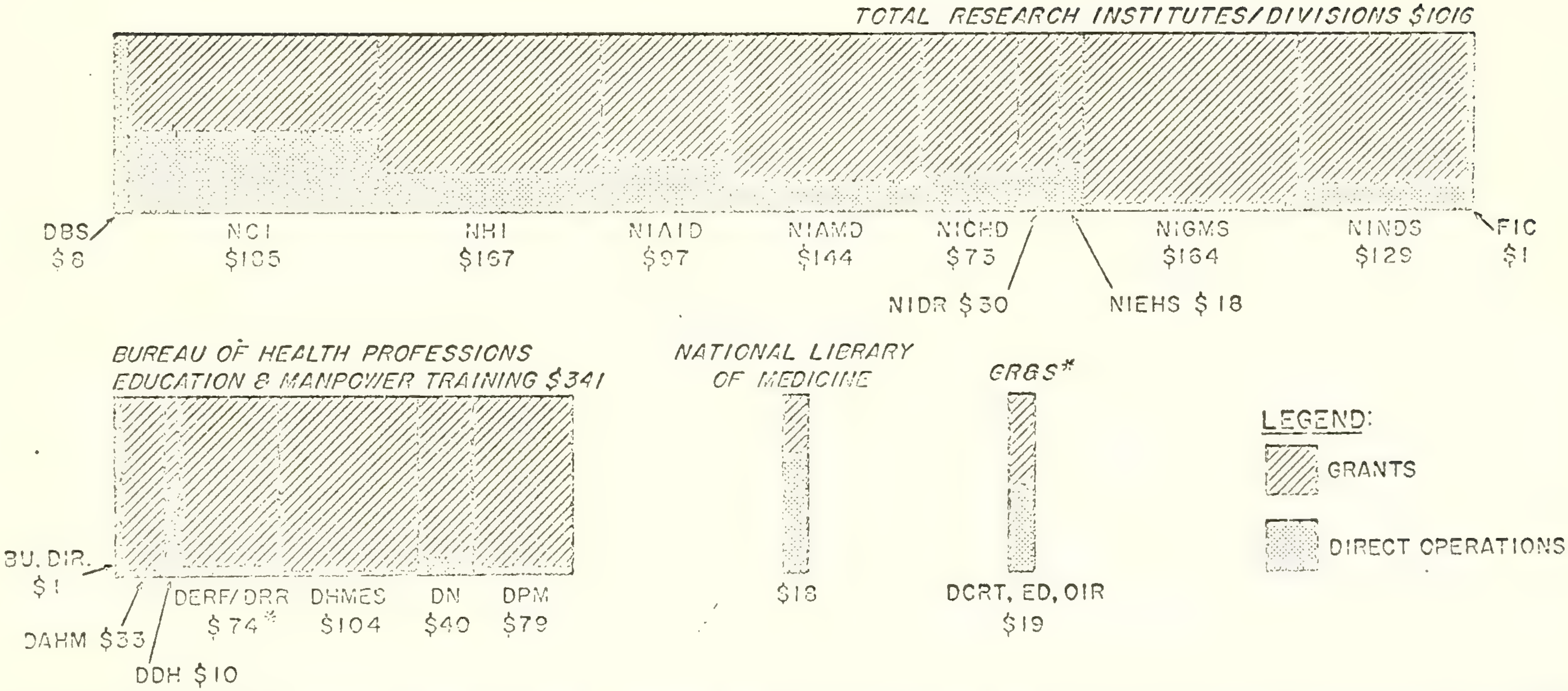
NIH GROWTH AND FUNCTIONS

CONSOLIDATED APPROPRIATIONS, FY 1955-FY 1969*



*CONTAINS ALL PRESENT AND FORMER NIH ACTIVITIES, INCLUDING MENTAL HEALTH THROUGH FY 1966 AND REGIONAL MEDICAL PROGRAMS FY 1966 - 1968. EXCLUDES DIRECT CONSTRUCTION. † BUT CONTAINS DIRECT TRAINING ($ 1 MILLION IN FY 1969). ‡ BUT CONTAINS SCIENTIFIC EVALUATION GRANTS ($ 3.2 MILLION FY 1969). ^ CONTAINS ALL OF BIOLOGICS STANDARDS ($ 8.5 MILLION IN FY 1969).

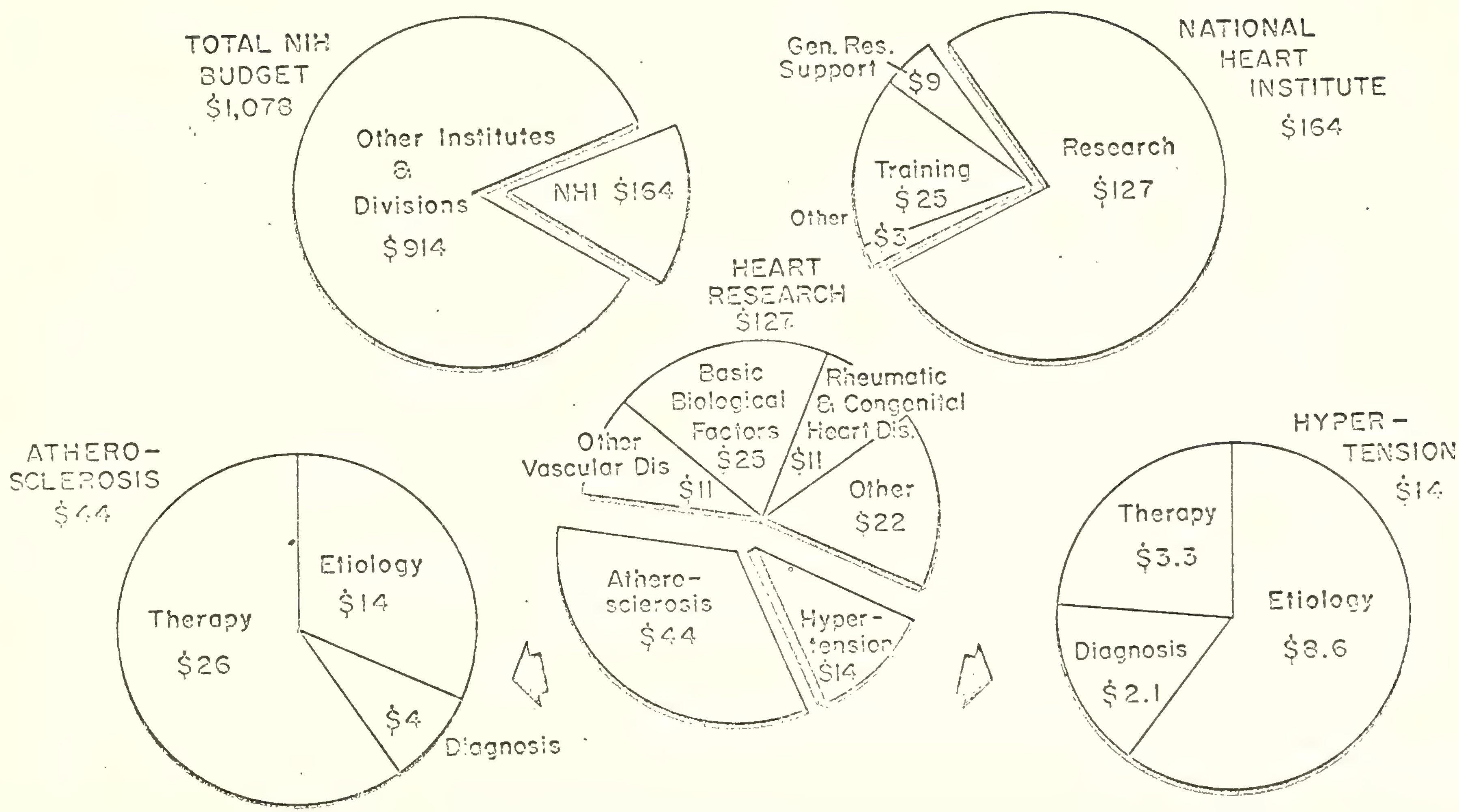
NIH APPROPRIATIONS, FY 1969
(MILLIONS OF DOLLARS)



NOTE: FINANCED BY REIMBURSEMENT FROM THE ABOVE APPROPRIATIONS: CC $ 16.3 MILLION, DRG $ 7.4 MILLION, DRS $ 12.5, & ADA $ 4.5 MILLION.
* DERF/DRR CONTAIN $ 66 MILLION TRANSFERRED FROM GR & S FOR FORMER DRFR ACTIVITIES. THESE BHPEMT DIVISIONS ALSO ADMINISTER $ 52.9 MILLION IN GENERAL RESEARCH SUPPORT GRANTS, FROM ABOVE INSTITUTE APPROPRIATIONS.

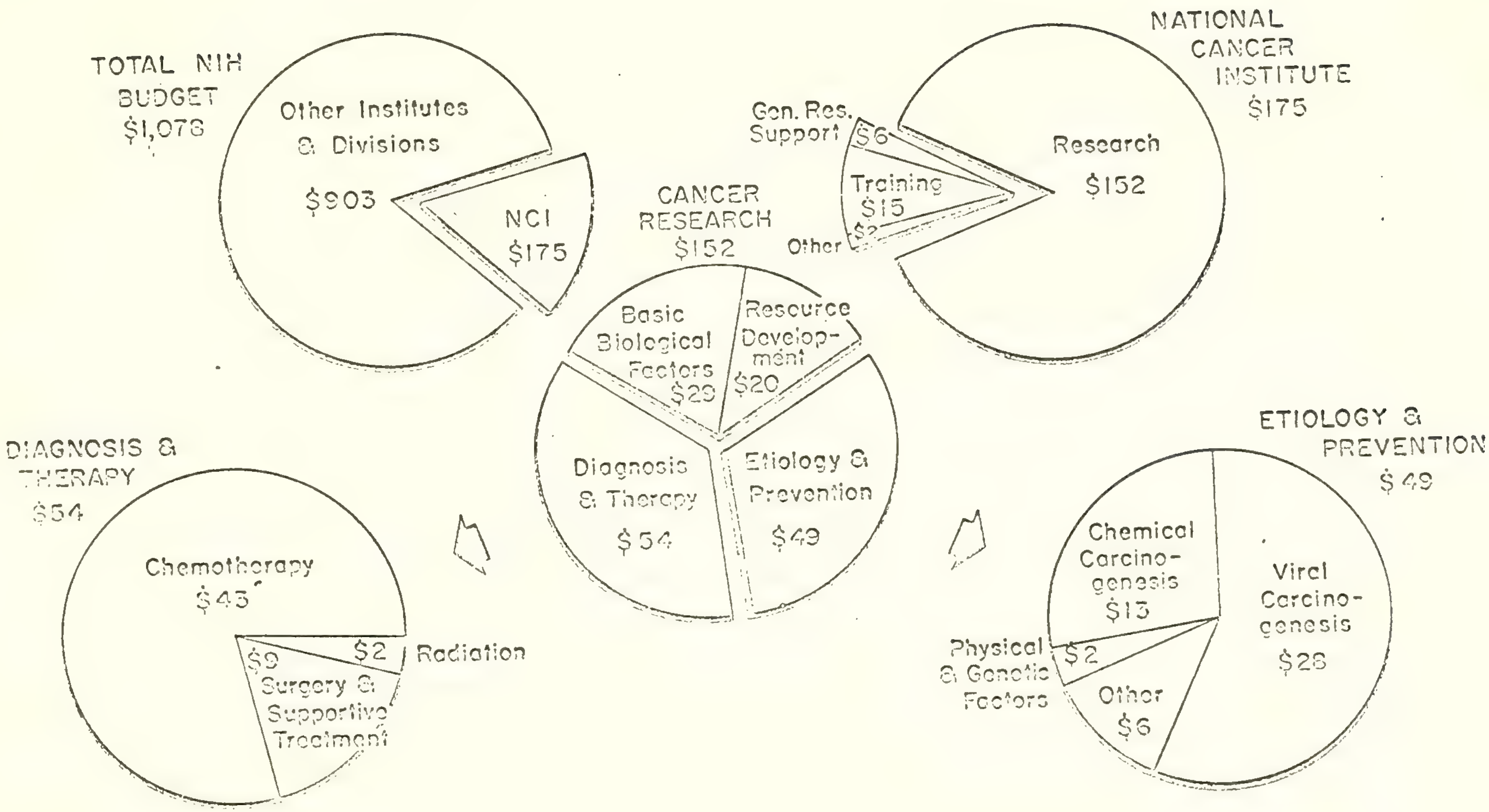
HEART DISEASE

FUND ALLOCATION, FY 1967 (MILLIONS)

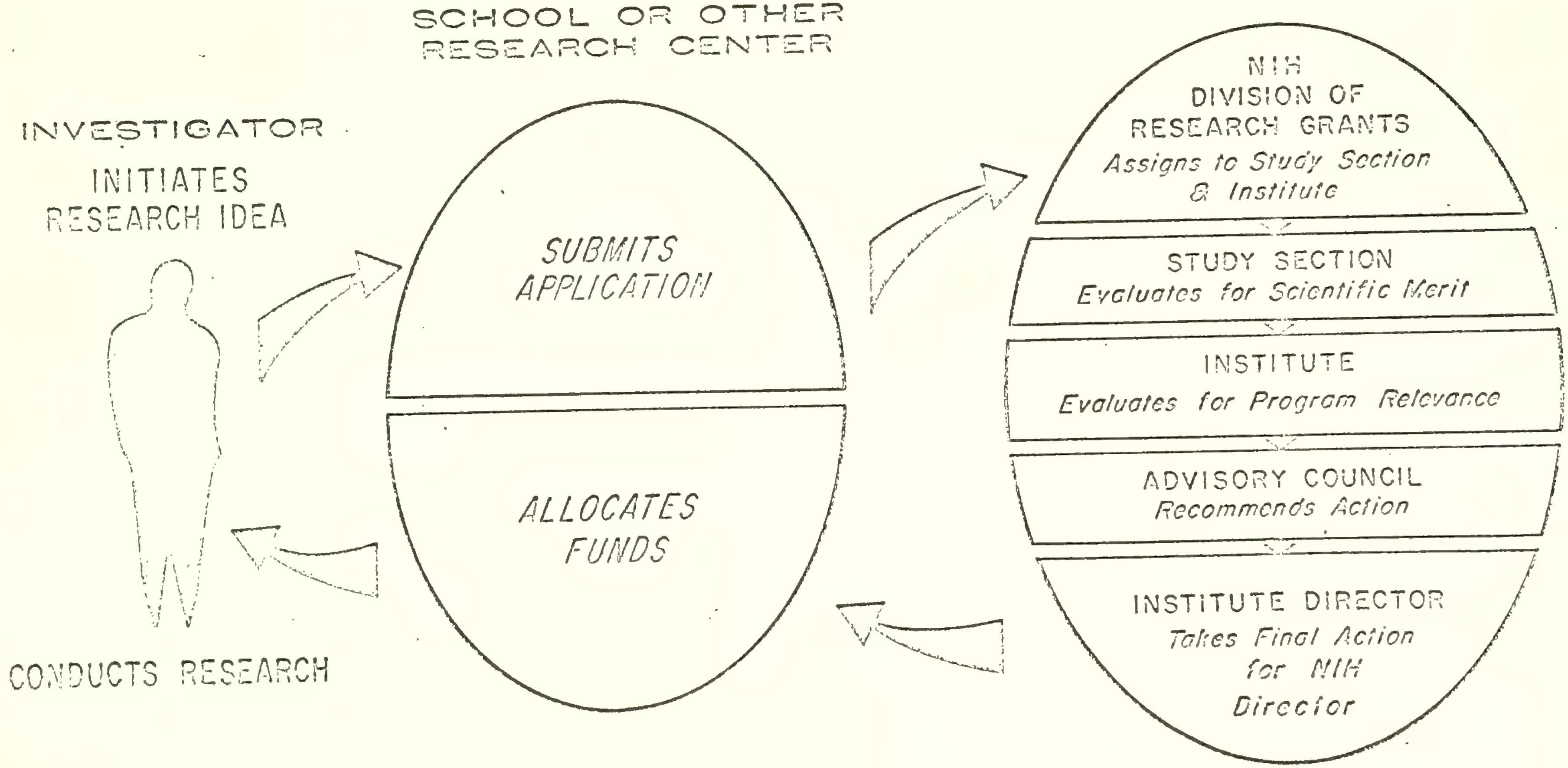


CANCER

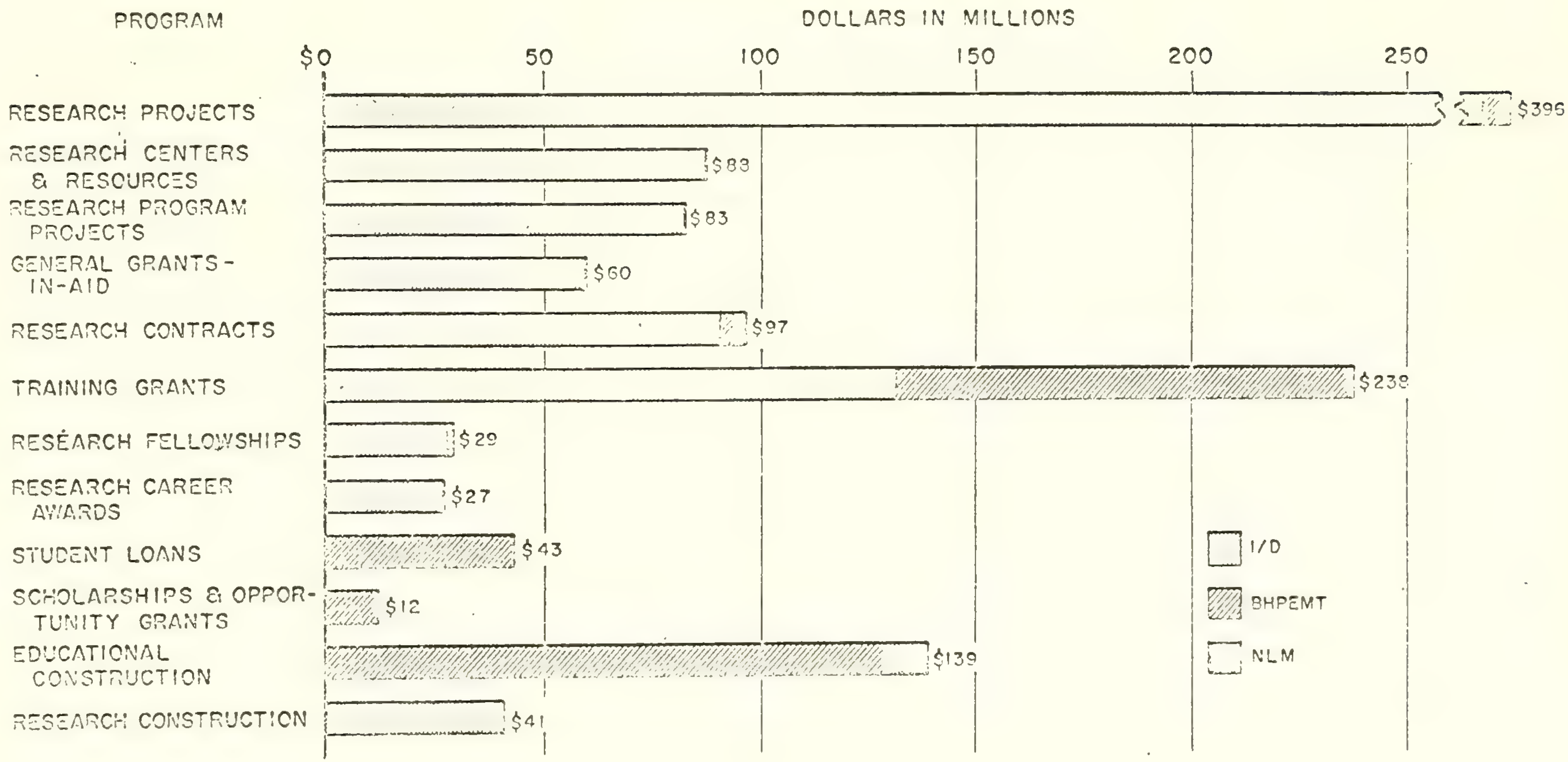
FUND ALLOCATION, FY 1967 (MILLIONS)



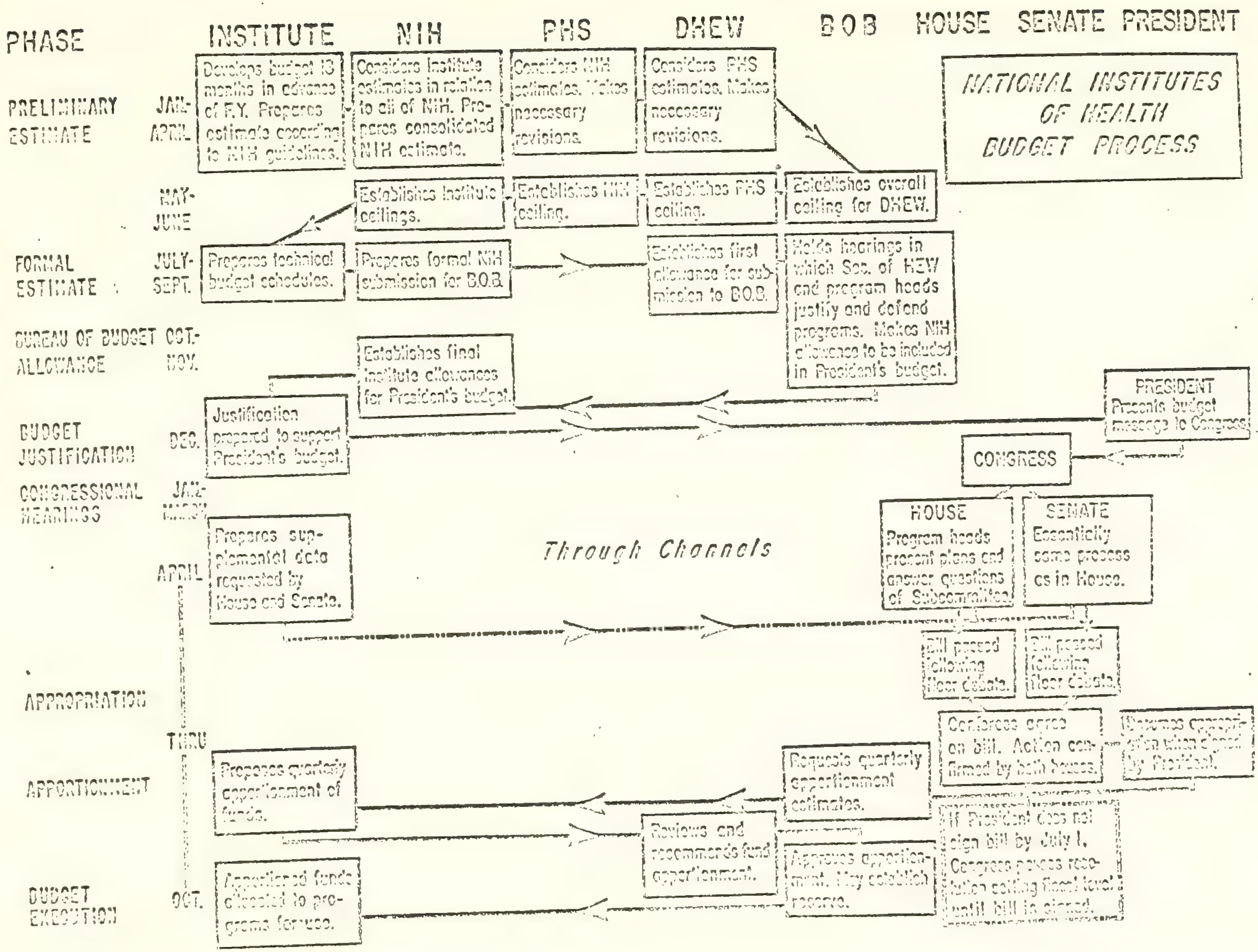
HOW A RESEARCH GRANT IS MADE



NIH GRANTS AND OTHER AWARDS BY TYPE OF AWARD, FY 1968



Slide 13.


NATIONAL INSTITUTES OF HEALTH BUDGET PROCESS
PHASE
INSTITUTE
NIH
PHS
DHEW
B O B
HOUSE
SENATE
PRESIDENT
PRELIMINARY ESTIMATE
JAN-APRIL
Develops budget 13 months in advance of F.Y. Prepares estimate according to NIH guidelines.
Considers Institute estimates in relation to all of NIH. Prepares consolidated NIH estimate.
Considers NIH estimates. Makes necessary revisions.
Considers PHS estimates. Makes necessary revisions.
MAY-JUNE
Establishes Institute ceilings.
Establishes NIH ceiling.
Establishes PHS ceiling.
Establishes overall ceiling for DHEW.
FORMAL ESTIMATE
JULY-SEPT.
Prepares technical budget schedules.
Prepares formal NIH submission for B.O.B.
Establishes first allowance for submission to B.O.B.
Holds hearings in which Sec. of HEW and program heads justify and defend programs. Makes NIH allowance to be included in President's budget.
BUREAU OF BUDGET ALLOWANCE
OCT-NOV.
Establishes final Institute allowances for President's budget.
BUDGET JUSTIFICATION
DEC.
Justification prepared to support President's budget.
PRESIDENT
Presents budget message to Congress.
CONGRESSIONAL HEARINGS
JAN-MARCH
CONGRESS
HOUSE
Program heads present plans and answer questions of Subcommittee.
SENATE
Essentially same process as in House.
Through Channels
APRIL
Prepares supplemental data requested by House and Senate.
Bill passed following floor debate.
Bill passed following floor debate.
APPROPRIATION
THRU
Conferees agree on bill. Action confirmed by both houses.
Becomes appropriation when signed by President.
APPORTIONMENT
Prepares quarterly apportionment of funds.
Requests quarterly apportionment estimates.
Reviews and recommends fund apportionment.
If President does not sign bill by July 1, Congress passes resolution setting fiscal level until bill is signed.
Approves apportionment. May establish reserve.
BUDGET EXECUTION
OCT.
Apportioned funds allocated to programs for use.

NEW BUDGET AUTHORITY, FISCAL 1969
(From January budget, in billions of dollars)

1. National defense	$ 82.3
2. Relatively uncontrollable civilian programs, open-ended programs, and fixed costs:	
Social Security, medicare, and other social insurance trust funds	46.1
Interest	14.4
Civilian and military pay increase	1.6
Veterans pensions, compensation, and benefits	5.4
Public assistance grants	5.8
Farm price supports (Commodity Credit Corporation)	3.4
Postal operations	.3
Legislative and judiciary	.4
Other	3.5
Subtotal, defense and relatively uncontrollable civilian programs	163.2
3. Relatively controllable civilian programs	43.6
4. Undistributed intragovernmental payments (−)	−5.0
Total, new budget authority proposed, 1969	201.7

DHEW BUDGET AUTHORITY—FY 1970
Noncontrollables and Controllables
(Millions of dollars)

Agency	Total	Noncontrollables	Controllables
Total DHEW	$59,024	$51,781	$7,243
Total Federal funds	$17,481	10,238	$7,243
CP & EHS	233	—	233
HSMHA	1,305	17	1,288
NIH	1,499	1	1,498
OE	3,589	88	3,501
SRS—grants to States	8,712	8,118	594
Medical assistance		(3,057)	—
Maintenance assistance		(3,719)	—
Other		(1,342)	—
SSA—payments to institutions	2,015	2,015	—
Health insurance for aged		(1,545)	—
Other		(469)	—
Other specials	127	—	127
Total SSA trust funds	$43,553	$43,553	—
Fed. old age & survivors ins.	32,385	32,385	—
Federal disability insurance	4,358	4,358	—
Federal hospital insurance	5,467	5,467	—
Fed. supplementary medical ins.	1,864	1,864	—
Other adjustments	−2,533	−2,533	—

Slide 16.

THE ELECTRON MICROSCOPE

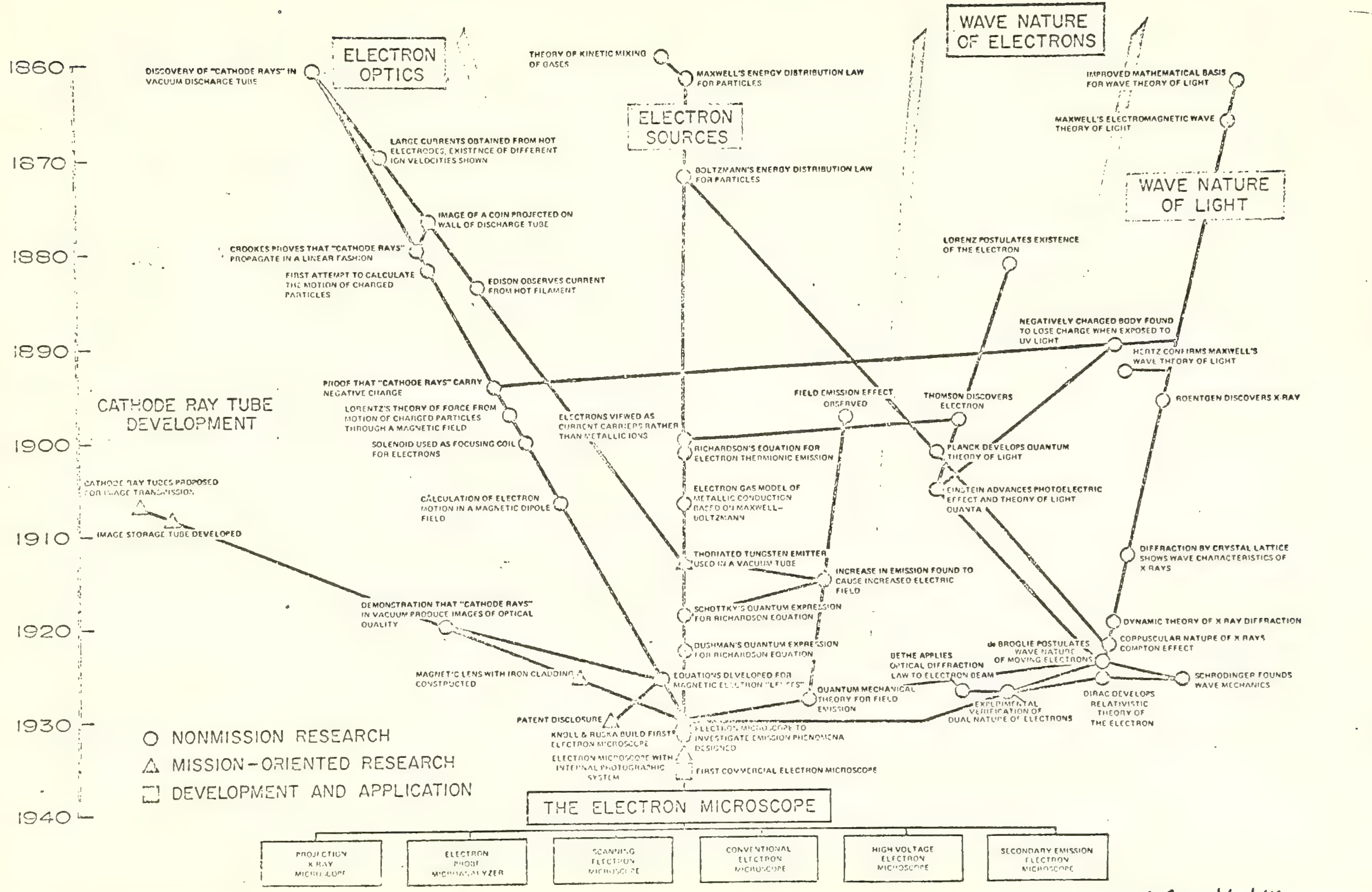
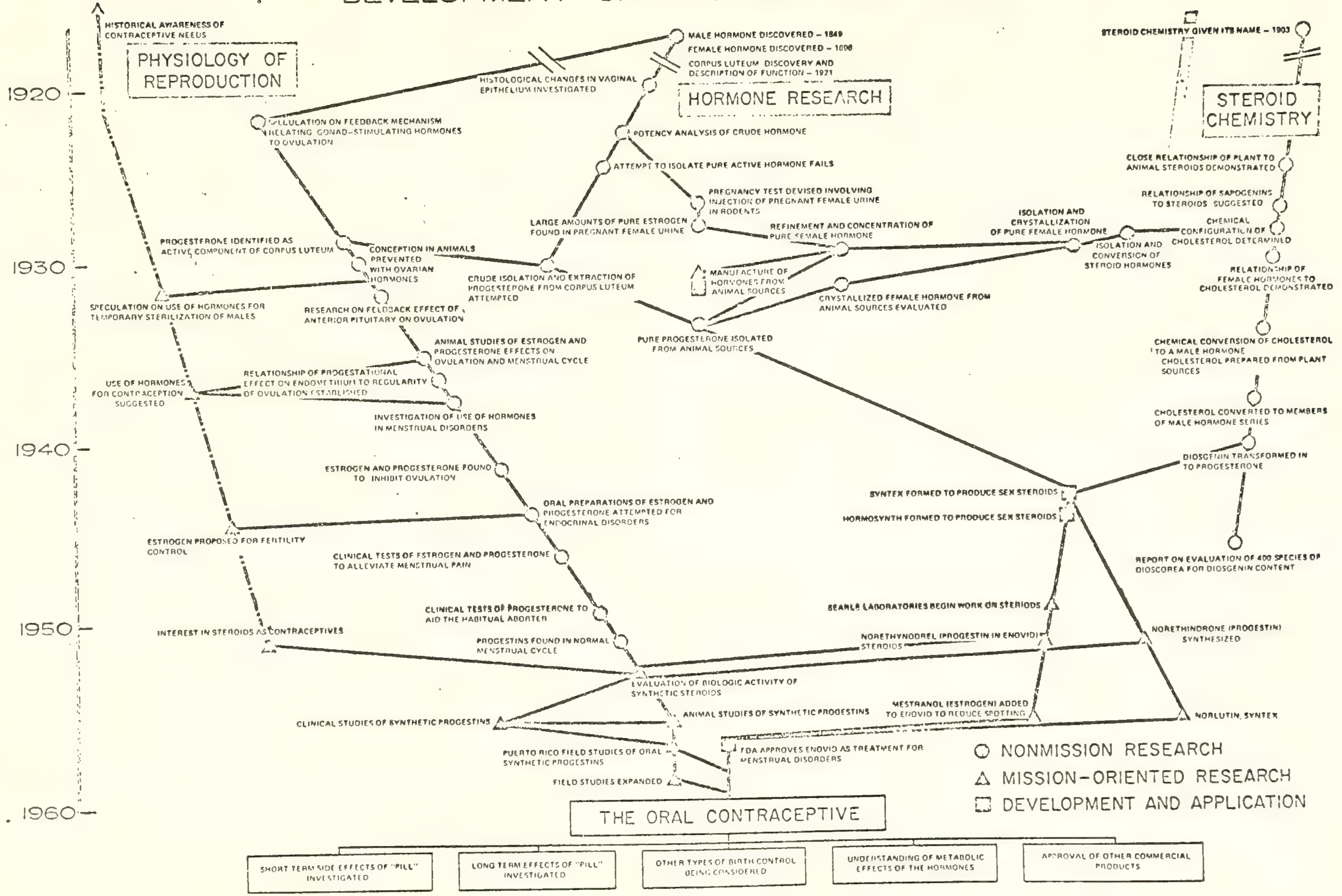


Exhibit 17

DEVELOPMENT OF THE ORAL CONTRACEPTIVE



TAB 2

National Expenditures for Biomedical Research*

Robert W. Berliner, M.D.,† *and Thomas J. Kennedy, M.D.*‡

The Council of Academic Societies has taken an important and constructive step in deciding to study the problem of the appropriate level for the nation's investment in biomedical research. Speaking for the NIH, we certainly wish them well in this effort and look forward to further discussions in the development of ideas concerning this extremely difficult issue.

Background

A brief review of the history of the support of biomedical research over the last three decades will lend some perspective.

World War II provided the impetus for a heavy national investment in biomedical research. Prior to the early 1940's, research played a minor role, at least in the budgeting of academic institutions; the scale was small, and the goals were defined by the individual faculty member. Total national expenditures for medical research were approximately $45 million, of which $3 million were derived from Federal sources, $25 million from—and consumed by—industry, $12 million from foundations and voluntary health agencies, and $5 million from endowments. The success of research in solving major problems intimately connected with the war effort—including but not limited to medical and health problems—facilitated post-war public investments in science and technology. Research activities in all sectors—academic, industrial, and governmental—began to expand; research became professionalized; and the patronage and sponsorship patterns began to shift. The following data are illustrative:

1. Table 1 reflects the growth in national expenditures for research and, the larger element, development. They rose from $2.9 billion in FY 1950 to roughly $27 billion for FY 1970. Biomedical research increased from $160 million in FY 1950 to nearly $2.7 billion in FY 1970. Over these two decades the percentage of the total devoted to medical research almost doubled, from 5.6 to 9.8 percent.

2. Table 2 depicts the pattern of growth in Federal financial support of biomedical research. By 1947 the total national investment had almost doubled (from $45 million to $87 million), accounted for principally by an expansion in the role of the Federal Government, a carry-over from war-time traditions and precedents. Since 1947 the investments in medical research and development by both the Federal and non-Federal sectors have expanded significantly. The annual Federal investment is now about $1.7 billion, representing 62 percent of the biomedical research expenditures of the Nation.

* Presented by Dr. Berliner before the Council of Academic Societies, Association of American Medical Colleges, Chicago, Illinois, February 6, 1970.

† Deputy Director for Science, National Institutes of Health, U. S. Department of Health, Education, and Welfare.

‡ Associate Director for Program Planning and Evaluation, NIH, DHEW.

TABLE 1
U.S. MEDICAL RESEARCH AS A PROPORTION OF ALL R & D, 1950–1970
(Dollars in millions)

Fiscal Year	Total R & D	Medical R & D	Percent
1950	2,900	161	5.6
1955	6,279	261	4.2
1960	13,730	845	6.2
1965	20,449	1,837	9.0
1966	22,285	2,053	9.2
1967	23,680	2,266	9.6
1968	25,330	2,440	9.6
1969 est.	26,250	2,595	9.9
1970 est.	27,250	2,660	9.8

3. Figure 1 shows a graphic summary of the sources of funds for biomedical research. While not shown in this figure, the rates of growth in the investments of industry and state governments have been roughly equivalent to those of the Federal Government, but the private sector's contributions have been increasing less rapidly.

4. A more detailed analysis of Federal sponsorship (Table 3) shows that the DHEW is the major supporter of biomedical research. In the late forties, the Atomic Energy Commission and the Department of Defense played major roles, contributing respectively twenty-six and fourteen percent of the total Federal support. Currently, each of these two agencies and the National Aeronautics and Space Administration account for six to seven percent of the Federal sponsorship. The DHEW share is attributable principally to the

TABLE 2
FEDERAL MEDICAL RESEARCH SUPPORT AS A PROPORTION OF ALL MEDICAL R & D, 1940–1970
(Dollars in millions)

Fiscal Year	Total Medical	Federal Medical	Nonfed. Medical	Percent
1940	45	3	42	6.6
1947	87	27	60	31.0
1950	161	73	88	45.3
1955	261	139	122	53.3
1960	845	448	397	53.0
1965	1,837	1,174	663	63.9
1966	2,053	1,316	737	64.1
1967	2,266	1,459	807	64.4
1968	2,440	1,571	869	64.4
1969 est.	2,595	1,656	939	63.8
1970 est.	2,660	1,652	1,008	62.1

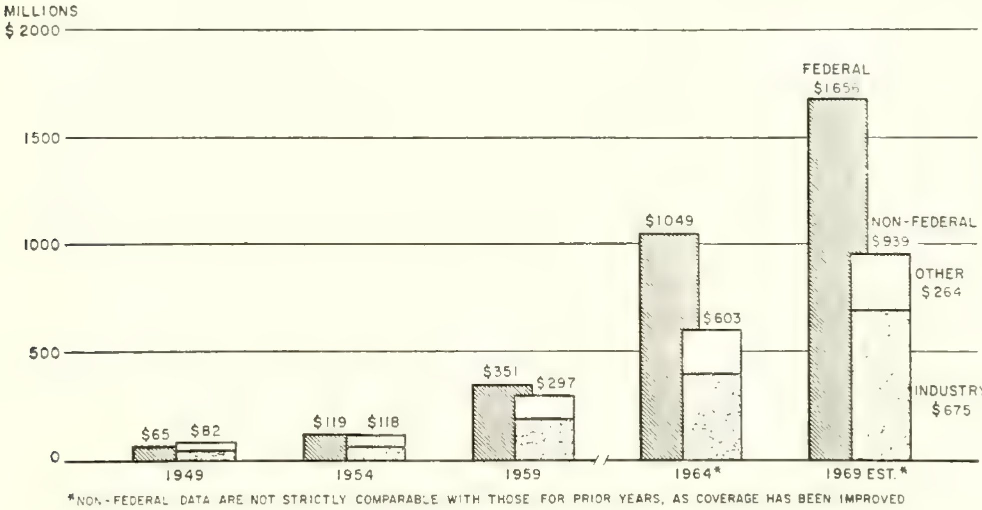


FIGURE 1
Sources of medical research funds 1949–1969.

TABLE 3

FEDERAL SUPPORT FOR MEDICAL RESEARCH, FY 1949–1969*
(Dollars in millions)

Department	1949 Amount	1949 Percent	1959 Amount	1967 Amount	1968 Amount	1969 Est. Amount	1969 Est. Percent
Total	*$65*	*100.0*	*$351*	*$1,459*	*$1,571*	*$1,656*	*100.0*
AEC	17	26.2	44	96	95	98	5.9
Defense	9	13.8	32	118	114	118	7.1
DHEW	31	47.6	238	1,051	1,128	1,174	70.9
NIH	(25)	(38.5)	(212)	(812)	(864)	(890)	(53.7)
NASA	—	—	—	82	109	117	7.1
NSF	—	—	8	14	21	26	1.6
VA	4	6.2	13	45	46	50	3.0
Other	4	6.2	16	53	58	73	4.4

* Covers biomedical research (projects, resources and general support) but not training or construction.

NIH (which included the National Institute of Mental Health until 1967).

Thus, the NIH accounts for about a third of all support for biomedical research. Of course, its role is larger if the focus is placed on academic research, since little of the industrial investment goes to academic institutions. If, in addition, contributions to research training and of research training to the conduct of research itself are taken into consideration, the NIH role is larger yet.

This perspective makes it clear that a very large part of the question related to the appropriate level of national investment in biomedical research is a matter of the appropriate level of NIH investment. Since academic deliberations and recommendations are unlikely to influence significantly either industry or the other components of the private sector, the identity of the universities' problem and NIH's in terms of actionability, is even closer. In view of this common concern, it may be of interest to review the processes by which the level of spending is established each year.

The Budget Process

Figure 2 is a flow chart of the steps involved in this process, which normally takes eighteen to twenty-one months to run its course. The route is tortuous. The first part of the cycle, which lasts approximately one year, is a continuous effort on the part of each level in the Executive Branch to convince the next higher level of the reasonableness of its proposals and then to adjust to the limits imposed.

The process thus entails convergence, with progressively damped oscillations, on some final figure between the initial proposals from below and the ceilings established by higher authority.

The debate ends with the formal presentation of the budget to the Congress. From that time, each Federal administrator must support the President's Budget, no matter how many errors and injustices he may feel have been wrought upon this program in the budgetary process. Chaos would ensue if a public administrator could with impunity defy his boss and plead his own special interests to the Congress and the public.

In hearings before the Congressional appropriations committees, program directors defend the requests of the President. These committees rely not only on the administrators from the Federal agencies, but also on a wide spectrum of other experts, sometimes selected by the

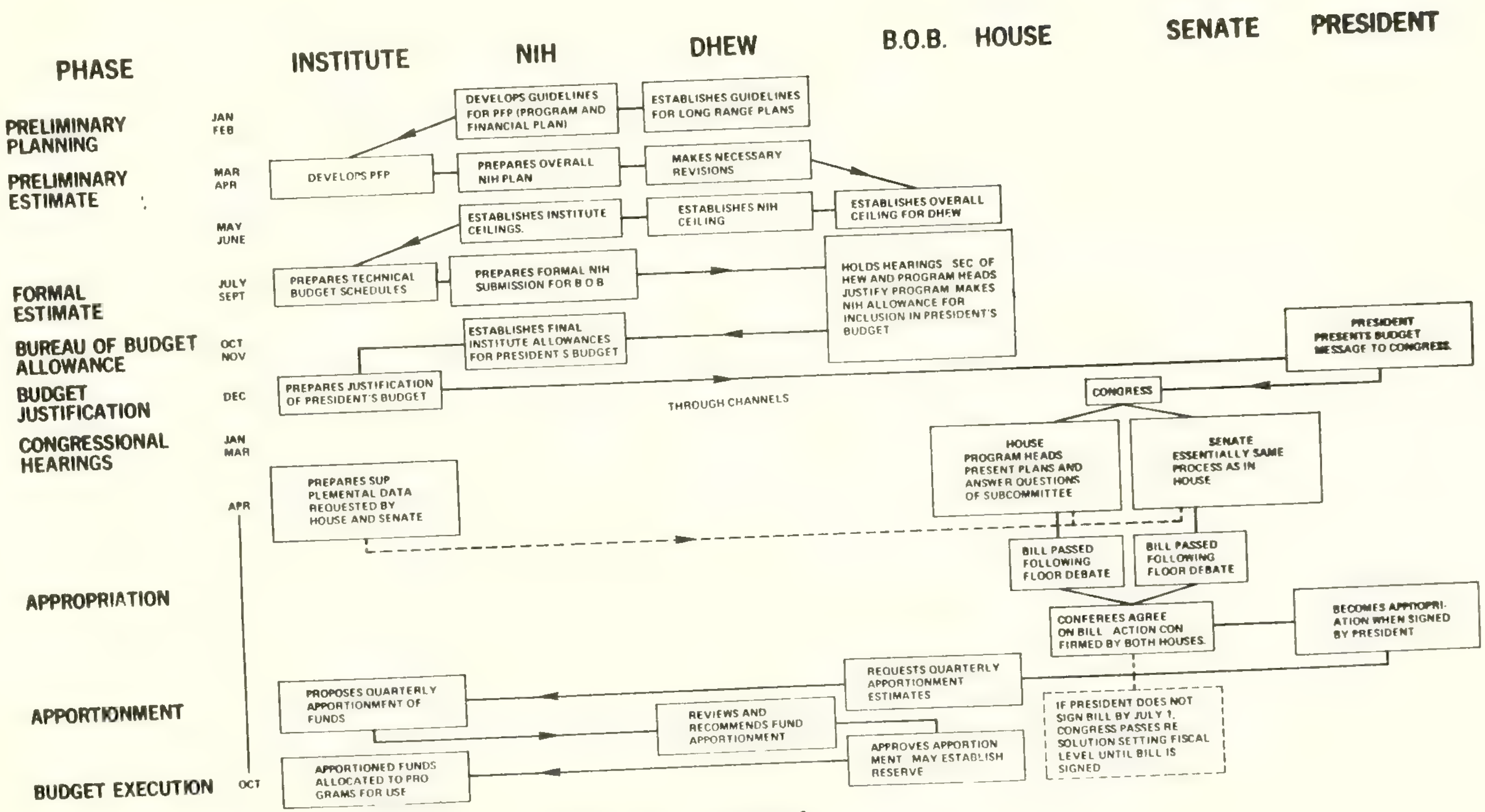


FIGURE 2
National Institutes of Health Budget Process

committees, sometimes self-selected. Nongovernmental members of the biomedical research community have developed considerable skill and a strong tradition of placing before the Congress their critique of all or specific segments of the President's Budget.

When the House of Representatives and the Senate have each completed action on the President's Budget and reconciled any differences between the two chambers, the appropriation bill goes to the President for his signature. Following this, the agency submits its plan for apportioning the appropriated funds for use over the four quarters of the fiscal year—that is, if there are four quarters left when the appropriation is passed. This is reviewed by the Office of the Secretary and by the Bureau of the Budget; and as a result, there may be revisions in the plan, including withholding of authority to use some of the appropriated funds. This withholding of authority to spend, or to use the technical term, the establishment of a reserve, is usually based on a judgment either that the particular sums involved cannot be effectively used or that their use would not be in accord with the President's policy.

THE DECISION MAKING

So much for process. What about the *determinants* of decisions? For the President, the budget is the basic document that embodies the specific programs of the Administration and the intensity of effort, or at least of funding, to be devoted to these programs. The President's choice of programs, and particularly of program emphasis, reflects his interpretation of his election mandate, modulated by a continuing evaluation within his own political philosophy of what is in the best interest of the nation. The budget is the blueprint of the President's programs. Advice on program comes from the Cabinet Officers he has chosen as his major advisors, from his own staff, from his confidants throughout the nation, from his party leaders in the Congress, and from the political tradition he represents. The President must try to convert his broad election mandate into specific programs, realizing that continuity of power in his hands or his political party will depend heavily on the development of appropriate and popular programs and their successful and acceptable implementation.

Quantitative dilemmas relate to accurate forecasting of the electorate's attitudes on the balance between public and private investment and to appraisals of the probable effects of taxation and public spending policies on the economy of the nation and the world. For quantitative advice the President relies on a small, highly qualified staff of experts collectively known as the Bureau of the Budget. This generally very competent group exerts a strong influence throughout much of the budget process as well as in the ultimate obligation of funds.

No President ever starts with a clean slate. He assumes leadership of an ongoing enterprise that has traditions, inflexibilities, and obligations that have been built up over the years. The magnitude of these—represented in Table 4—is often surprising to the uninitiated.

THE "UNCONTROLLABLES"

1. Obligations for national defense are the largest single item in the budget. They are vast, continuing, and only moderately increased by such demands as those of the Vietnam War. They reflect the high price that this country pays for what is assumed to assure its security. These expenditures may be viewed as relatively fixed and uncontrollable.

2. A number of civilian programs re-

TABLE 4

NEW BUDGET AUTHORITY, FISCAL 1969

(From January budget, in billions of dollars)

1. National defense	$82.3
2. Relatively uncontrollable civilian programs, open-ended programs, and fixed costs:	
Social Security, medicare, and other social insurance trust funds	46.1
Interest	14.4
Civilian and military pay increase	1.6
Veterans pensions, compensation, and benefits	5.4
Public assistance grants	5.8
Farm price supports (Commodity Credit Corporation)	3.4
Postal operations	.3
Legislative and judiciary	.4
Other	3.5
Subtotal, defense and relatively uncontrollable civilian programs	163.2
3. Relatively controllable civilian programs	43.6
4. Undistributed intragovernmental payments (−)	−5.0
Total, new budget authority proposed, 1969	201.7

quire essentially mandatory expenditures. Expenditures from the social insurance trust funds are mandated by specific statutes. Payment of interest on the national debt is not discretionary. Promises and commitments to veterans cannot be breached. Funding of a number of programs in the domain of public assistance and farm price supports are governed by explicit formulae laid down in legislation.

3. Thus, the total of the demands on the budget made by national defense and uncontrollable civilian programs represented, in FY 1969, the last completed fiscal year, about eighty percent of the total budget.

4. The residual twenty percent available for discretionary expenditure is the maximum that the President can program to leave his personal imprint on the nation.

In examining the determinants of the decisions of the operating agencies, we shall limit the scope of the discussion to biomedical research and specifically to the National Institutes of Health. Thus, we shall omit reference to NIH health manpower activities, and we shall not include the smaller program of the National Library of Medicine. Our object is to select the programs and their funding level that will best further the essential biomedical research mission of the NIH.

THE NATIONAL INSTITUTES OF HEALTH: ITS MISSION

It is important that everyone share a clear and unambiguous understanding of this mission. The usual definition of the mission of the NIH—to support basic and applied biomedical research—is dangerously incomplete, because it fails to identify the purpose to which Federal support is directed. Research is an activity pursued out of many motives and purposes, with different ones assuming primacy in differing contexts.

An investigator may be driven by his desire to achieve understanding and conceptual mastery; by the joy he experiences from success in solving problems; by his aspirations for fame and, usually somewhat less, for fortune symbolized by the departmental chairmanship or the Nobel Prize; by the gratification that he derives from discovery that alleviates human suffering and blunts the toll of disease.

An academic institution fosters research for a number of reasons. The requirements of scholarship include the creation of new knowledge as well as the preservation and transmission of existing knowledge. The institutional image upon which recruitment and retention of scholars depends is highly colored by the research accomplishments of the faculty. The conduct of research is the other side of the coin called

graduate education—that is, research is the methodology of graduate education, at least in the physical and biological sciences.

Federal funds expended for research by the NIH are not, as in the case of the National Science Foundation, for research as research. The NIH is not a science agency; it is a health agency. Science is the means, health the objective. Funds are appropriated to the NIH to conduct, support and coordinate research, to the extent that these activities are relevant to the maintenance of the health of the American people and to the causes, diagnosis, treatment and prevention of physical and mental diseases.

The NIH has sought to invest in biomedical research projects that will advance its mission, whether or not the investigator or the institution was moved by the same muse as was the Government. The basic role of the National Advisory Councils is to assure the mission relevance of the scientifically meritorious projects supported.

We might digress just a moment to react to an "outside" view of the mission of the NIH that has gained considerable currency—namely, that support from the Institutes and research Divisions of the NIH (the old NIH) was thinly disguised and backdoor support for medical education. When after World War II it appeared probable that continuing large-scale public support for medical research would materialize, a decision was reached, for a variety of reasons, to select, as an institutional base for the effort, the nation's graduate schools and, in particular, its medical schools. Research and development in the physical sciences and engineering continue to depend primarily on industrial performers. Aid to medical education *per se* was not a primary or major objective of the focusing of Federal research support in medical schools. Certainly this decision has resulted in a major expansion of the size of the faculties of medical schools (by scholars primarily dedicated to research), and the participation of these scholars in the education of undergraduate students has enriched and extended the content of the curriculum. From the point of view of the research mission of the NIH, however, these must be regarded as second-order benefits, and major significance is attached to the enormous amount of new knowledge created in the last two decades and to the imaginative applications of new and existing knowledge to the solution of previously intractable problems of disease. Of course, the NIH also recognized, even before it assumed responsibility for health manpower, that the nation's medical schools are the source and site of its major research competence, and that maintenance of the health of those schools is essential to its mission.

BUDGETARY RESULTS

Returning to the budget process, the next two tables illustrate the product of that process: the President's 1971 budget for the NIH. One table reflects organizational structure; the other, program activities.* Table 5 presents, by organizational component, the level of actual obligations for the fiscal year ending on June 30, 1969, and the expected obligations for FY 1970 and 1971, the latter based on the President's requests. The 1971 President's Budget would provide a net increase of $66 million—4.6 percent—in the operating level for the entire NIH. It also reflects an increase of $93 million over the adjusted 1970 appropriation. Of this, $62

* The tables and related text update the authors' address of February 6. They represent estimated obligations for FY 1970 and 1971, following the passage of the DHEW appropriations for FY 1970.

TABLE 5

NIH Budget: FY 1969 Actual Obligations and FY 1970 and 1971 Estimates

(Dollars in millions)

NIH component	1969 actual	1970 est. oblig.	1971 est. oblig.	Increase 1971/70	1969 = 100 1970	1971
Total	*$1,471*	*$1,450*	*$1,516*	*$66*	*99*	*103*
Institutes & research Divisions, Total	*1,003*	*974*	*1,036*	*62*	*97*	*103*
NCI	182	181	203	21	99	112
NHLI	161	161	172	11	100	106
NIDR	30	29	35	6	98	117
NIAMD	141	132	132	0	94	94
NINDS	104	96	97	1	92	93
NIAID	102	98	99	1	97	98
NIGMS	160	148	148	0	93	93
NICHD	71	75	93	19	105	131
NEI	22	24	26	2	111	119
NIEHS	18	18	20	2	99	111
DBS	8	8	9	1	100	113
FIC	4	3	3	0	75	75

million is for the Institutes and research Divisions, including the following major increases for the research programs: (*a*) the National Cancer Institute, especially for viral carcinogenesis studies; (*b*) the National Institute of Child Health and Human Development, especially for the program on population and family planning; (*c*) the National Heart and Lung Institute, especially for investigations related to atherogenesis; (*d*) the National Institute of Dental Research, especially for work on caries; and (*e*) the National Institute of Environmental Health Sciences and the National Eye Institute to get their embryonic programs off the ground. The other four Institutes—Neurology and Stroke, Arthritis and Metabolic Diseases, Allergy and Infectious Diseases, and General Medical Sciences—will hold at about their 1970 levels, which are generally below those of 1969.

Table 6 is organized by broad classes of program activity encompassing the entire NIH. An additional $15 million is requested for the regular research grant programs. Increases are also proposed for the specialized research centers and, to a lesser extent, for the general and categorical clinical research centers. These increases are offset by a twenty percent reduction in the funds requested for the general research support program.

"Collaborative research and development" describes work usually undertaken at the initiative of the Government, generally through research contracts, and frequently awarded to nonacademic performers. The very substantial increase of $40 million represents the emphasis on research in viral oncology and in family planning, population control, and contraceptive technology. These are areas in which academic institutions have much to contribute, and it is hoped that they will compete for the use of these funds.

Funds for research fellowships are slightly reduced, while those for training grants are at approximately the same levels in FY 1970 and 1971.

This is the budget that has been submitted to Congress and will be defended by the NIH in its appropriation hearings

TABLE 6

NIH BUDGET BY PROGRAM ACTIVITIES: FY 1969 ACTUAL OBLIGATIONS AND FY 1970 AND 1971 ESTIMATES

(Dollars in millions)

Program activity	1969 actual	1970 est. oblig.	1971 est. oblig.	Increase 1971/70
Total	*$1,471*	*$1,450*	*$1,516*	*$66*
Regular research grant programs	*460*	*440*	*455*	*15*
Noncompeting	309	317	322	5
Competing	151	123	133	10
Special research grant programs	*161*	*157*	*158*	*1*
General research support	53	50	40	−10
Categorical clinical research centers	11	10	11	1
General clinical research centers	35	35	38	3
Specialized research centers	14	14	21	7
Other	48	48	48	0
Collaborative R & D	*122*	*127*	*167*	*40*
Research training programs	*201*	*183*	*182*	*−1*
Fellowships	55	47	45	−2
Training grants	146	136	137	1
All other programs	*527*	*541*	*553*	*13*

this year. The decisions of the Congress, while formally "semi-final," usually prevail unless the President wishes to withhold all or part of the Congressional increases. Thus, the political process is the final determinant of the level of national research investment. The task is, then, to provide a rational and logical framework for the political decision-makers to determine what ideally should be spent on biomedical research.

Theoretical Bases for Aggregate Funding Level

In the early 1960's, some unusually perceptive individuals, including Mr. William Carey of the Bureau of the Budget, began to foresee that the then current rate of growth of the nation's science budget could not long continue and began an intensive examination of the basic questions now before this Council. There have been a number of illuminating contributions, among which the reports to the House Committee on Science and Astronautics by the National Academy of Science entitled *Basic Research and National Goals* (1965) and *Applied Science and Technological Progress* (1967) stand out. It would seem worthwhile to mention a few of the ideas that have been offered and to discuss some of the problems their application presents.

A number of papers take the position that research expenditures represent a necessary overhead if the larger activity to which they relate is to grow, stay modern, and avoid obsolescence.

OVERHEAD ON THE GNP

It has been argued that the research expenditures of a nation can be viewed as the necessary overhead for its national growth and development, and thus should be coupled to the Gross National Product. Tying the budget for research to the

TABLE 7

Aggregate National Health Expenditures, by Type of Expenditure, Calendar Years 1929–68
(Dollars in Billions)

Type of expenditure	1929	1940	1950	1960	1965	1966	1967	1968
Total	*$3.6*	*$4.0*	*$12.9*	*$27.0*	*$40.6*	*$45.1*	*$50.9*	*$57.1*
Health services and supplies	3.4	3.8	11.9	25.1	36.8	41.1	46.7	52.4
Construction	0.2	0.1	0.8	1.0	1.9	2.0	2.0	2.3
Research	—	0.05	0.2	0.8	1.8	2.1	2.3	2.4
Research as a percent of total health	—	1.3	1.6	3.0	4.4	4.7	4.5	4.2

GNP has the virtue of proving compensation for the rises in costs due to inflation as well as seeing that research keeps pace with the growth of the nation as a whole.

OVERHEAD ON MEDICAL CARE EXPENDITURES

For biomedicine, perhaps a more attractive and logical alternative is to relate medical research more directly to the universe it serves. Table 7 shows the national expenditures for health over the last forty years. The citizens of this country spent fifty-seven billion dollars on health in 1968; and if present trends continue, these costs will continue to expand. The bulk of the expenditures included in the total are for health services. Research, which is regarded by some as an investment in product improvement, by others as a deferred health service, constitutes a relatively small fraction of the total medical expenditure. Intuitively, it would appear to make some sense to consider research investments as an overhead on health care costs and to fix research at some reasonable fraction of the total cost of health.

This approach has the merit of being more susceptible to a comparison of costs with benefits—for example, the costs that the health care system has been spared as a result of the development of viral vaccines (as for polio, rubella, measles); innovations in antibiotic chemotherapy (tuberculosis, syphilis); and the introduction of psychoactive drugs. The benefits from these accomplishments alone exceed by far the total investment since 1940 in biomedical research. There is of course no guarantee that striking benefits will continue, but it is a fairly safe assumption that they will.

A particularly attractive aspect of this approach to determine the level of funding is that it discourages attempts at seeking "trade-offs" between medical care and medical research. It emphasizes that the great demands for medical services constitute a pressure for *increased* medical research rather than a reason for taking funds from medical research to meet the demands for care. It also underlines the great preponderance of care costs over research costs and makes clear how little any funds that might be taken from research would, in fact, bolster medical care.

On the other hand, it encourages the fallacious reasoning that research expenditures should be proportional to the cost of the specific problem to be studied—the view that any problem can be solved if enough money is spent on it. In fact, the distribution of funds must be determined by an assessment of the scientific opportunities, a determination as to which fields

are ripe for exploitation. The size of the expenditure for research on a particular problem should certainly be influenced by its importance, but this cannot be the sole, or even the primary, determinant.

EXPLOITATION OF AVAILABLE MANPOWER

Another possible method of determining the level of research investment might be to set it at the level required to utilize the available manpower. Certainly, the availability of competent manpower sets a limit on the amount that can be effectively expended. In the long run, however, this method carries unacceptable elements of positive feed-back. If any level of manpower will be supported, there is pressure for excessive expansion of the manpower pool.

Conversely, a determination to reduce expenditures for research can be effected by cutting off the supply through the training process. In the long run this method begs the question of the appropriate level of research and is inherently unstable.

PLANNED AND REGULAR GROWTH

Dr. Harvey Brooks suggested several years ago that the country should commit itself to the goal of annually increasing its investments in research, development, and technology. In what he defined as "little science," he advocated that increases should be quantitatively sufficient to offset price inflation, to support the increased costs attributable to increasing complexity of science—new instruments, computers, etc.—and finally to provide funds to expand the level of program activity by exploring new areas of science and introducing new scientists into the system. The Brooks proposal has been a convenient whipping boy, since empirical support for the explicitly proposed exponent for growth is lacking. To the extent that Brooks suggested a national commitment to maintain the present level of program activity, there is no great problem. The difficulty is in determining the appropriate increment.

COST-BENEFIT ECONOMICS

In recent years, there has been an increasing effort to treat decisions about the level of research expenditures as an investment problem and to try to evaluate which of all the possible marginal investments of funds will produce the greatest (measurable) economic benefits to the investor. Thus, research advocates are asked to demonstrate the economic value of their proposals. Ideally, the value of the investment should be equivalent to the value of the return. If investment exceeds return, money has been wasted. If return exceeds investment, opportunities have not been exploited fully.

This approach is beset with formidable conceptual and practical difficulties. How might one assign an economic value to an advance in medical care that derives from medical research, even if the medical care result could be predicted before the research was done? For some parts of the result, one could estimate the costs avoided in reduced days of hospitalization, in reduced payments for physicians or drugs, and in additional days of employment. Clearly, however, these are far from the total gains sought by society when it supports efforts to find new measures for preserving health. How much do we assign for reduced pain, discomfort, deprivation? How much for a life saved? These are questions that could be explored at great length; but when one has finished, he would still have no generally acceptable answer. The conclusion must be that there is no answer possible in the framework of economic investment theory; it is a matter of taste and judg-

ment. We spend what we can afford within the limits of what respected scientific judgment predicts to be fruitful for the goals we seek.

DISJOINTED OPPORTUNISTIC INCREMENTALISM

Actually the level of NIH funding has been arrived at by what has been aptly called "disjointed opportunistic incrementalism"—a term apparently picked up from economist friends and introduced by Philip Handler. The NIH, like other components of the Federal Government, does not develop a new budget each year from a zero base. Since 1945 a complex system and network for the conduct of biomedical research has developed in the United States, and the Federal Government through the NIH is both a part of this system (through its inhouse laboratories and clinics) and the major patron of it. To revalidate each component every year would be a monumental undertaking and one that would threaten the stability of the entire structure it supports. Instead, the annual budget formulation process enables the NIH to effect marginal changes in its components, and simultaneously to continue its commitments to the mainstream of the national research effort. Even this limited intervention is not easy. The NIH presently support: about 11,000 research grants requiring about $600 million annually; about 16,000 trainees under research training grants requiring $136 million; and about 4,500 fellowships and career development awards requiring about $47 million.

Obviously this universe is too large for central decisions on individual items. The first level at which detailed judgments are reached is in the Institutes. These must try to determine the fiscal requirements to continue productive existing commitments, to phase out unproductive work in orderly fashion, to make new commitments that exploit scientific opportunity emerging from research progress, and to modulate all proposals in view of the limitations of trained manpower, facilities, and other necessary resources.

Although this situation has been arrived at without preconceived plan and without precise ties to any particular system for setting its level, it should not be dismissed out of hand. Lacking any particular way of deciding the appropriate absolute level for research, one might as well select something of the order of magnitude that now exists—one that does provide the research environment essential to our institutions of higher education, that utilizes the talents of the majority of those with high levels of training and capacity in the field, and that provides the capacity for self-renewal in the education and training of young people. It is important, of course, that the base not be eroded by inflation. In particular, the increments should include developmental efforts. Although these need not be built permanently into the base, the large sums of money that they require should not be allocated at the expense of that base, essentially one of fundamental biomedical science.

Criteria for Decisions on Allocation

Whether an aggregate total level of expenditures for biomedical research is arrived at from "above" by an "overhead" type of estimate, or from "below" by "disjointed incrementalism" the development of a detailed expenditure plan must eventually depend upon allocation decisions. In the domain of biomedical research, the questions related to criteria applied for allocation of funds must be addressed. These become progressively more undefinable in operational form as the stage of action enlarges. To decide the

relative importance of health science, nuclear science, physical science, or social science is part of the overall problem. The calculus for establishing relative priorities for health, education, welfare, urban renewal, national defense, urban transportation, conservation, recreation is another. What is more determinative: the probability of success or the importance of the problem? How are these related?

In reality, however imperfect the decision-making theory, decisions must be reached if the existing system is to continue. A vast amount of soul-searching goes into every annual Federal budget cycle in which such choices are regularly made.

The problem has two major dimensions—technical and political. The technical aspects are complex and difficult. Yet it is impossible to evade the responsibility of developing the most logical, rational, and objective evidence to support proposals to invest public funds in biomedical research. The final judgment depends on how much the people of the nation wish to pay for a research program in absolute terms, as well as in relation to the other social benefits in which they can invest. A sound political decision will not be made until the average citizen or his representative understands certain elements: the issues and problems of disease; the cost of establishing, maintaining, and expanding an effective research apparatus; and the probability of solutions to the problems with and without a research effort.

TAB 3

1887 Hygienic Laboratory. PHS begins bacteriologic research at port of New York.

1930 Under Ransdell Act, Laboratory becomes National Institute of Health, authorized to study all diseases of man. Authority to award research fellowships.

937 National Cancer Institute created, with programs of direct research, fellowships, clinical training, and grants for cancer research and control. National Advisory Cancer Council.

1938	NIH moves to Bethesda, Md.
1944	Public Health Service Act, giving general authority for research and research support.
1945	Research Grants Office established at NIH to administer extramural projects transferred from war-time Office of Scientific Research and Development.
1947	First training grants (NCI) and noncategorical research fellowships.
1948	NIH becomes National Institutes of Health.

1948-
1950

Categorical approach to disease broadened. New Institutes with authority to study--

- o heart disease
- o allergy and infectious diseases
- o dental disease
- o mental illness
- o arthritis and metabolic diseases
- o neurological diseases.

Extramural programs expanded for research and graduate training. National Advisory Councils for each Institute.

1953	Clinical Center opens at NIH.
1956	Health Research Facilities Act, with matching grants for research construction.
1958	Division of General Medical Sciences established to support basic research.
1962	Institutional grants awarded through new Division of Research Facilities and Resources.

1963-1967

New Institutes for studies on—

- child health and human development
- general medical sciences.

New Divisions for —

- computer research and technology
- environmental health sciences.

Collaborative research extended.

Regional Medical Programs established to advance treatment of heart disease, cancer and stroke.

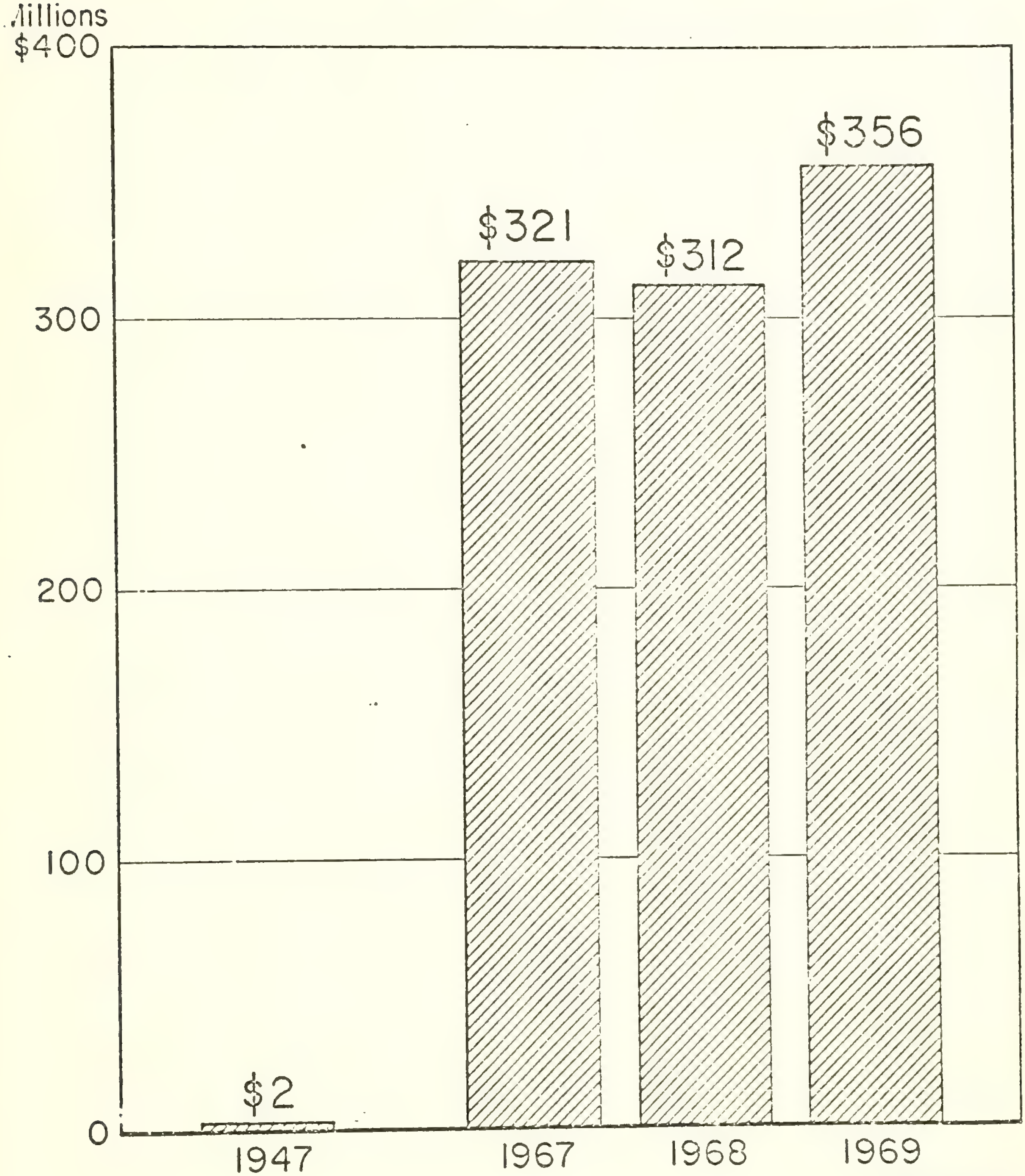
National Institute of Mental Health becomes separate bureau of PHS.

NIH OBLIGATIONS FOR VARIOUS BUDGET CATEGORIES: 1960-1970
(in millions of dollars)

Budget Category	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970 1/
Total Budget (I/RD)	337	456	566	652	760	837	929	1034	1085	1024	1039
Total Extramural Program (I/RD)	283	396	499	570	660	729	806	909	947	946	879
Total Extramural Research	192	273	364	414	474	519	579	684	719	728	699
Regular Research Grants	163	220	266	311	351	370	402	444	456	455	436
Special Program Grants	10	24	49	41	52	56	79	104	111	116	107
General Research Support Grants	--	--	18	26	30	39	39	45	54	53	50
Research Contracts	20	28	31	36	41	54	58	90	97	105	106
Training Grants	49	70	77	86	98	106	124	134	135	142	132
Fellowships (incl.Career Awards)	13	18	23	30	35	40	45	49	52	55	47
Research Facilities Construction	29	35	36	40	54	65	59	42	41	22	1
Total Academic Science (I/RD)	211	292	372	434	492	554	610	690	710	724	678
Research	137	189	255	292	338	372	413	483	510	529	517
Training and Fellowships	54	77	88	103	115	127	148	163	166	176	161
Facilities Construction	20	27	29	39	39	55	49	35	35	19	0
Total Medical School Academic Science (NIH, incl. NIMH)	145	209	280	302	357	397	439	482	478	508	481
Research	92	131	195	207	241	262	287	325	314	348	336
Training and Fellowships	40	58	65	79	94	103	121	138	142	154	145
Facilities Construction	14	21	21	16	22	32	31	18	22	6	0
Total Medical School Academic Science (I/RD)	NA 2/	NA	NA	NA	NA	NA	NA	436	429	452	425
Research	NA	NA	NA	NA	NA	NA	NA	308	295	327	315
Training and Fellowships	NA	NA	NA	NA	NA	NA	NA	110	112	119	110
Facilities Construction	NA	NA	NA	NA	NA	NA	NA	18	22	6	0

1/ Funds available for obligation (excludes OMB reserves)
2/ Figures not available

DHEW OBLIGATIONS TO MEDICAL SCHOOLS FOR SUPPORT OF RESEARCH, 1947 AND 1967-1969



ORA-OADPPE-NIH
December 1970

Table 7

Estimated Federal Obligati[illegible] to Schools of Medicine
by Program, FY 1950-1969
(in millions)

Fiscal Year	Total: Total	Total: NIH	Total: Other Agencies	Research: Total	Research: NIH	Research: Other Agencies	Training: Total	Training: NIH	Training: Other Agencies	Construction: Total	Construction: NIH	Construction: Other Agencies	Other Programs: Total	Other Programs: NIH	Other Programs: Other Agencies
1970		$601.6			$317.2			$122.8			$100.7			$ 60.9	
1969	$804.7	$588.5	$ 216.2	$415.9	$327.8	$ 88.1	$173.5	$121.3	$ 52.2	$ 99.2	$ 96.4	$ 2.8	$116.0	$ 43.2	$ 72.8
1968	722.8	548.5	174.3	376.2	298.5	77.7	169.9	116.3	53.5	109.8	108.6	1.2	67.0	25.1	41.9
1967	670.8	443.7	227.1	373.4	308.0	65.4	164.7	112.2	52.5	90.2	18.3	71.9	42.5	5.2	37.4
1966	549.3	481.9	61.3	335.2	287.0	48.2	126.1	121.1	5.0	79.9	31.1	48.8	8.1	-	8.1
1965	494.1	439.9	41.4	298.7	261.9	36.8	107.2	102.8	4.4	88.0	32.3	55.7	.2	-	.2
1964	399.8	357.1	38.5	277.0	241.2	35.8	97.9	94.3	3.6	24.9	21.6	3.3	-	-	-
1963	339.9	301.8	32.4	236.5	207.3	29.2	82.2	79.0	3.2	21.2	15.5	5.7	-	-	-
1962	314.3	280.3	27.1	219.3	194.9	24.4	67.4	64.7	2.7	27.6	20.7	6.9	-	-	-
1961	237.3	209.4	21.3	149.9	130.5	19.4	59.7	57.8	1.9	27.7	21.1	6.6	-	-	-
1960	165.1	145.3	16.4	106.4	91.5	14.9	41.5	40.0	1.5	17.2	13.8	3.4	-	-	-
1959	126.3	110.9	13.6	80.0	67.6	12.4	27.9	26.7	1.2	18.4	16.6	1.8	-	-	-
1958	99.9	78.9	11.6	60.0	49.4	10.6	18.2	17.2	1.0	21.7	12.3	9.4	-	-	-
1957	87.6	74.8	10.2	49.4	39.7	9.7	14.7	14.2	.5	23.5	20.9	2.6	-	-	-
1956	46.7	29.0	9.8	31.0	21.5	9.5	7.8	7.5	.3	7.9	-	7.9	-	-	-
1955	28.1	18.6	8.3	26.9	18.6	8.3	-	-	-	1.2	-	1.2	-	-	-
1954	25.1	16.0	7.6	23.6	16.0	7.6	-	-	-	1.5	-	1.5	-	-	-
1953	23.6	12.1	8.2	20.3	12.1	8.2	-	-	-	3.3	-	3.3	-	-	-
1952	30.7	11.2	7.5	18.7	11.2	7.5	-	-	-	12.0	-	12.0	-	-	-
1951	21.9	8.8	7.3	16.1	8.8	7.3	-	-	-	5.8	-	5.8	-	-	-
1950	15.9	10.6	5.3	8.2	8.2	-	-	-	-	7.7	2.4	5.3	-	-	-

Note: See explanatory notes attached

Office of Resources Analysis AD/PP.
National Institutes of Health

Estimated Federal Obligations to Schools of Medicine
FY 19[illegible] 1969
(millions of dollars)

Fiscal Year	Total	DHEW	NIH	AEC	NASA	DOD	NSF	All Other
1970		$ 791.3	$ 601.6					
1969	$ 804.7	$ 771.8	$ 588.5	$ 14.8	$ 1.5	$ 10.2	$ 6.1	$ .2
1968	722.8	686.2	548.5	17.9	.6	11.4	6.2	.6
1967	670.8	641.9	443.7	13.6	.6	8.6	5.8	.3
1966	549.3	526.0	481.9	3.7	.0	7.9	7.8	3.9
1965	494.1	470.7	439.9	3.7	1.5	9.6	6.6	2.0
1964	399.8	377.1	357.1	3.6	2.1	10.9	6.0	.1
1963	339.9	318.7	301.8	4.2	.9	10.3	5.3	-
1962	314.3	295.7	280.3	3.9	.5	8.8	5.4	-
1961	237.3	221.3	209.4	3.9	.2	7.6	4.3	-
1960	165.1	151.5	145.3	3.6	.0	6.6	3.4	-
1959	126.3	114.6	110.9	3.3	-	6.1	2.3	-
1958	99.9	89.9	78.9	3.0	-	5.7	1.3	-
1957	87.6	78.0	74.8	2.9	-	5.8	.9	-
1956	46.7	37.2	29.0	2.9	-	5.8	.8	-
1955	28.1	19.8	18.6	2.8	-	5.0	.5	.0
1954	25.1	17.6	16.0	2.6	-	4.6	.2	.1
1953	23.6	15.4	12.1	2.5	-	5.5	.1	.1
1952	30.7	23.1	11.2	2.3	-	4.9	.0	.4
1951	21.9	14.6	8.8	2.1	-	4.3	-	.9
1950	15.9	14.8	10.6	1.1	-	-	-	-

Note: See explanatory notes attached

Office of Resources Analysis AD/PP
National Institutes of Health
May 1970

FEDERAL BUDGETS FOR MEDICAL R&D, FY 1970-1972
(in millions)

Agency	1970 actual	1971 est. obligations	1972 est. obligations	Increase 1972/71	Percent increase
Total	$1,664	$1,930	$2,078	$148	8
VA	59	62	62	-	0
DoD	125	117	115	-2	-2
AEC	104	105	104	-1	-1
NASA	86	103	78	-25	-24
NSF	28	30	32	2	7
DHEW 1/	1,177	1,321	1,444	123	9
(NIH)	(873)	(1,057)	(1,185)	(128)	(12)
Agriculture	50	55	56	1	2
Environmental Protection Agency	-	85	100	15	18
Other	35	52	87	35	67

1/ For FY 1971 and FY 1972, excludes those research programs transferred to the Environmental Protection Agency, December 1970

Note: Covers support of medical and health-related R&D (projects, resources, and general support) but not training or construction

HISTORY OF THE HEALTH PROFESSIONS EDUCATIONAL ASSISTANCE ACTS

Year of Enactment	Programs Authorized	Eligible Professions
1963	Construction of Teaching Facilities	Medicine, Dentistry, Osteopathy, Pharmacy, Podiatry, Optometry, Nursing or Public Health
	Student Loans	Medicine, Dentistry, Osteopathy
1964 PL 88-654	Student Loans	Optometry
1965 PL 89-290	Basic and Special Improvement Grants	Medicine, Dentistry, Osteopathy, Optometry, Podiatry
	Scholarships	Medicine, Dentistry, Osteopathy, Optometry, Podiatry, Pharmacy
	Student Loans	Pharmacy, Podiatry
1966 PL 89-709	Construction	Veterinary Medicine
	Student Loans	Veterinary Medicine
1968 PL 90-490	Construction of Multipurpose Facilities	Medicine, Dentistry, Osteopathy, Optometry, Podiatry, Pharmacy, Veterinary Medicine
	Institutional Grants	Medicine, Dentistry, Osteopathy, Optometry, Podiatry, Pharmacy Veterinary Medicine
	Special Project Grants	Medicine, Dentistry, Osteopathy, Optometry, Podiatry, Pharmacy Veterinary Medicine
	Scholarships	Veterinary Medicine
	Study of Adequacy of Programs -Report by July 1, 1970	All Professions

Health Professions Educational Assistance program--construction grants, by discipline: fiscal years 1965-70

Discipline	Total 1/	Fiscal year awarded					
		1965	1966	1967	1968	1969	1970
Number of schools 2/ receiving grants: Total	124	25	21	37	27	17	25
Medicine	63	14	11	21	16	10	11
Osteopathic medicine	3	0	0	1	1	0	1
Dentistry	31	8	5	9	5	3	7
Optometry	5	2	1	0	2	0	0
Pharmacy	17	1	4	6	2	1	5
Podiatric medicine	0	0	0	0	0	0	0
Veterinary medicine	5	3/	0	0	1	3	1
Federal funds awarded (1,000's): Total	$647,793	$74,279	$61,903	$133,623	$115,668	$123,347	$138,973
Medicine	462,435	53,832	42,707	90,960	79,701	93,117	102,118
Osteopathic medicine	8,952	0	0	1,925	6,538	0	489
Dentistry	148,029	19,251	14,997	35,862	24,091	24,186	29,642
Optometry	5,137	1,156	1,182	0	2,799	0	0
Pharmacy	15,997	40	3,017	4,876	1,386	536	6,142
Podiatric medicine	0	0	0	0	0	0	0
Veterinary medicine	7,243	3/	0	0	1,153	5,508	582

1/ Total numbers of schools receiving grants may be less than sum of numbers by year because some schools received grants in more than 1 year.
2/ Including grants to university and affiliated hospitals.
3/ Included in program beginning in fiscal year 1966.

Health Professions Educational Assistance program--
institutional grants, by discipline: fiscal years 1966-70

Discipline	Total	Fiscal year 1966	1967	1968	1969	1970
Number of schools receiving grants:						
Total	-	159	171	170	172	261
Medicine	-	91	98	99	100	101
Osteopathic medicine	-	5	5	5	6	6
Dentistry	-	49	53	51 1/	51	51
Optometry	-	9	10	10	10	11
Pharmacy	-	2/	2/	2/	2/	70
Podiatric medicine	-	5	5	5	5	5
Veterinary medicine	-	2/	2/	2/	2/	17
Amount of grants (1,000's):						
Total	$152,777	$10,482	$30,000	$32,160	$33,636	$46,499
Medicine	87,966	6,566	18,781	20,242	21,123	21,254
Osteopathic medicine	4,655	356	983	1,063	1,126	1,127
Dentistry	38,693	2,975	8,441	8,860	9,213	9,204
Optometry	5,987	398	1,231	1,360	1,481	1,517
Pharmacy	10,196	2/	2/	2/	2/	10,196
Podiatric medicine	2,773	187	564	635	693	694
Veterinary medicine	2,507	2/	2/	2/	2/	2,507

1/ 2 dental schools which are phasing out their programs did not receive grants because they could not fulfill the legal requirements.
2/ Included in program beginning in fiscal year 1970.

Health Profess[illegible] Educational Assistance program--
special project grants, by discipline: fiscal years 1968-70

Discipline	Total	Fiscal year 1968	Fiscal year 1969	Fiscal year 1970
Number of schools receiving grants:				
Total	-	48	103	137
Medicine	-	23	60	79
Osteopathic medicine	-	2	4	6
Dentistry	-	11	26	35
Optometry	-	7	8	9
Pharmacy	-	1/	1/	2
Podiatric medicine	-	5	5	5
Veterinary medicine	-	1/	1/	1
Amount of grants (1,000's):				
Total	$96,7[illegible]6	$10,132	$32,364	$54,300
Medicine	60,[illegible]3	5,477	19,784	34,942
Osteopathic medicine	3,579	410	1,119	2,050
Dentistry	24,374	2,689	8,723	12,962
Optometry	4,612	638	1,685	2,239
Pharmacy	268	1/	1/	268
Podiatric medicine	2,978	918	1,053	1,007
Veterinary medicine	782	1/	1/	782

1/ Included in program beginning in fiscal year 1970.

Nurse Training--construction grants, by type of program: fiscal years 1965-70

Type of program	Total 1/	Fiscal year awarded 1965 2/	1966	1967	1968	1969	1970
Number of schools receiving grants:							
Total	147	12	26	41	28	33	9
Diploma	50	0	15	19	8	8	0
Associate degree	33	0	2	6	10	12	3
Baccalaureate and graduate	64	12	9	16	10	13	6
Federal funds awarded (1,000's):							
Total	$89,368	$5,664	$13,806	$22,877	$18,489	$20,565	$7,967
Diploma	24,244	0	7,149	7,079	5,058	4,958	0
Associate degree	12,478	0	856	1,509	2,809	5,964	1,340
Baccalaureate and graduate	52,646	5,664	5,801	14,289	10,622	9,643	6,627

1/ Total numbers of schools receiving grants may be less than sum of numbers by year because some schools received grants in more than 1 year.
2/ Only baccalaureate programs were eligible for construction grants in fiscal year 1965.

Nurse Training--project grants for improvement in nurse training, by type of program: fiscal years 1965-70

Type of program	Total	Fiscal year					
		1965	1966	1967	1968	1969	1970
Number of organizations receiving grants 1/:							
Total	-	36	69	94	99	90	124
Diploma	-	15	26	37	44	28	29
Associate degree	-	0	4	5	5	7	15
Baccalaureate	-	18	36	49	44	50	66
Graduate	-	3	3	3	6	5	9
Other	-	0	0	0	0	0	5
Amount of grants (1,000's):							
Total	$22,435	$1,990	$1,928	$3,518	$3,999	$4,000	$7,000
Diploma	4,845	553	533	944	1,038	508	1,269
Associate degree	1,780	0	237	200	273	288	782
Baccalaureate	14,306	1,304	1,142	2,315	2,399	2,967	4,179
Graduate	1,254	133	16	59	289	237	520
Other	250	0	0	0	0	0	250

1/ In fiscal year 1970, name of program was changed to special project grants and eligibility for participation was broadened to include agencies other than schools of nursing.

Public Health Training--construction grants: fiscal years 1965-70

Item	Total	Fiscal year awarded					
		1965	1966	1967	1968	1969	1970
Number of schools receiving grants	7 1/	3	1	2	1	1	0
Federal funds awarded (1,000's)	$19,327	$7,002	$735	$4,260	$276	$7,084	0

1/ Total is less than sum of numbers by year because 1 school received grants in more than 1 year.

Public Health Training--formula grants for
the provision of public health training: fiscal years 1959-70

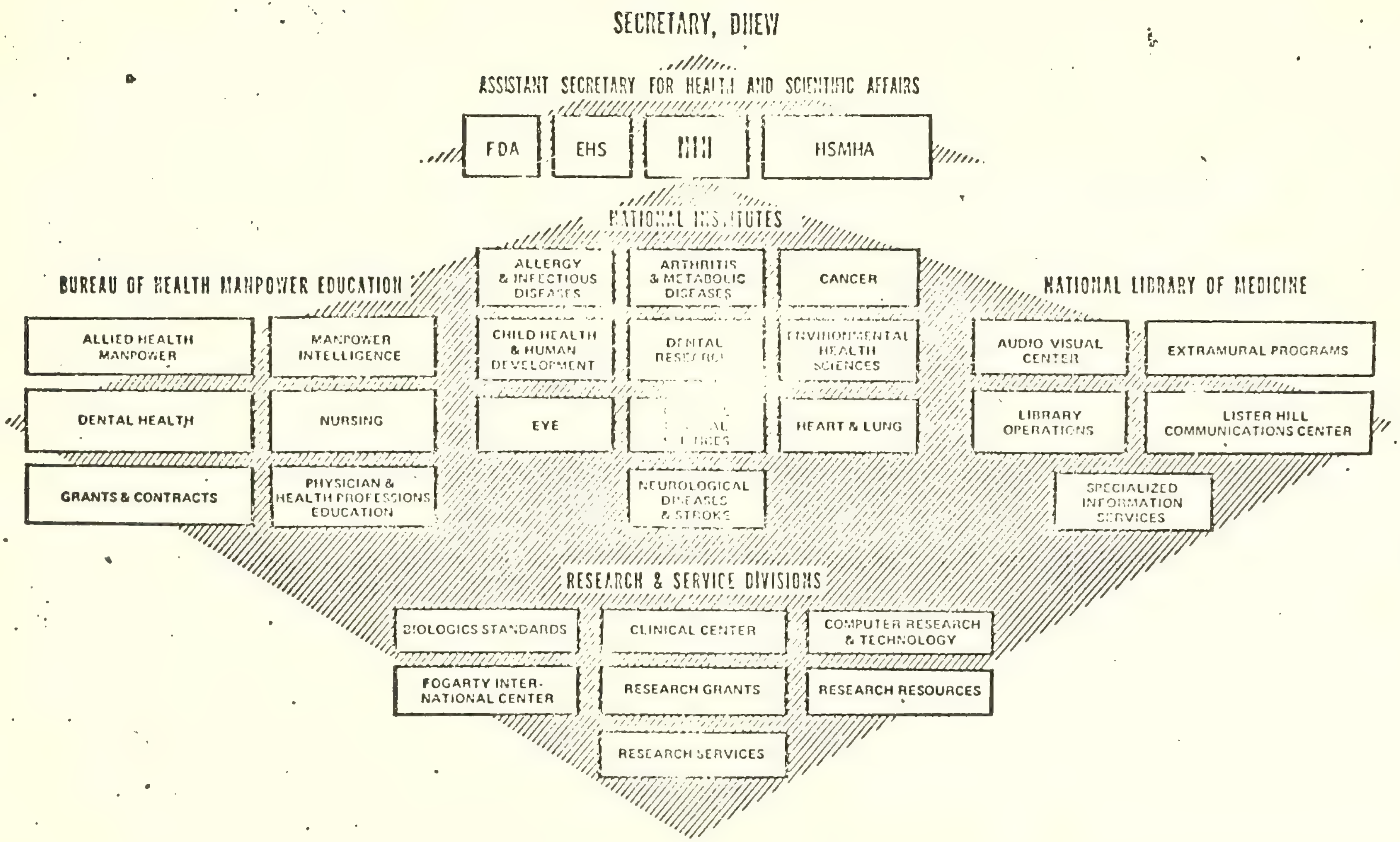
Item	Total	Fiscal year						
		1959-64	1965	1966	1967	1968	1969	1970
Number of schools receiving grants	-	12	12	13	13	15	15	16
Amount of grants (1,000's)	$30,281	$7,423	$2,500	$3,500	$3,750	$4,000	$4,554	$4,554

Allied Health Professions Personnel Training--
construction grants, by type of school: fiscal years 1967-70

Type of school	Total	Fiscal year awarded			
		1967	1968	1969	1970
Number of schools receiving grants:					
Total	6	0	1	5	0
Junior colleges	2	0	0	2	0
Senior colleges	3	0	1	2	0
Other	1	0	0	1	0
Federal funds awarded (1,000's):					
Total	$4,800	0	$1,792	$3,008	0
Junior colleges	428	0	0	428	0
Senior colleges	3,670	0	1,792	1,878	0
Other	702	0	0	702	0

Allied Health Professions Personnel Training--
basic improvement grants, by type of school: fiscal years 1967-70

Type of school	Total	Fiscal year 1967	1968	1969	1970
Number of schools receiving awards:					
Total	-	192	230	258	302
Junior colleges	-	28	35	42	69
Senior colleges	-	164	195	216	233
Amount of grants (1,000's):					
Total	$32,486	$3,285	$9,750	$9,750	$9,701
Junior colleges	4,816	423	1,315	1,371	1,707
Senior colleges	27,670	2,862	8,435	8,379	7,994


SECRETARY, DHEW
ASSISTANT SECRETARY FOR HEALTH AND SCIENTIFIC AFFAIRS
FDA
EHS
NIH
HSMHA
NATIONAL INSTITUTES
ALLERGY & INFECTIOUS DISEASES
ARTHRITIS & METABOLIC DISEASES
CANCER
CHILD HEALTH & HUMAN DEVELOPMENT
DENTAL RESEARCH
ENVIRONMENTAL HEALTH SCIENCES
EYE
HEART & LUNG
NEUROLOGICAL DISEASES & STROKE
BUREAU OF HEALTH MANPOWER EDUCATION
ALLIED HEALTH MANPOWER
MANPOWER INTELLIGENCE
DENTAL HEALTH
NURSING
GRANTS & CONTRACTS
PHYSICIAN & HEALTH PROFESSIONS EDUCATION
NATIONAL LIBRARY OF MEDICINE
AUDIO VISUAL CENTER
EXTRAMURAL PROGRAMS
LIBRARY OPERATIONS
LISTER HILL COMMUNICATIONS CENTER
SPECIALIZED INFORMATION SERVICES
RESEARCH & SERVICE DIVISIONS
BIOLOGICS STANDARDS
CLINICAL CENTER
COMPUTER RESEARCH & TECHNOLOGY
FOGARTY INTERNATIONAL CENTER
RESEARCH GRANTS
RESEARCH RESOURCES
RESEARCH SERVICES

THE MISSION OF NIH

TO ADVANCE HEALTH AND WELL-BEING THROUGH SUPPORT OF —

- *RESEARCH* on the diseases of man

- *EDUCATION* of manpower for research and health service

- *INSTITUTIONS* engaged in medical research and education

- *BIOMEDICAL COMMUNICATIONS*

THE CURRENT YEAR (FISCAL YEAR 1971) BUDGET

(In thousands)

Activity	F.Y. 1970 Actual	Fiscal Year 1971 Changes Over 1970: President's Budget	Congr. Approp.	1971 Column of 1972 Budget*
Institutes & Research Divisions				
Research grants..............	$592,689	+$15,030	+$79,821	+$70,603
Training grants & fellowships	155,971**	-1,732	+10,730	+3,289
Collab. res. (mostly contracts)	127,088	+43,072	+58,384	+58,828
Intramural research..........	90,302	+9,539	+13,401	+13,551
Other direct operations......	46,471	+2,850	+3,423	+3,823
Subtotal, IRD's............	1,012,521	+68,759	+165,759	+150,094
Bureau of Health Manpower Educ.				
Medical, dental and related health professions.........	301,257**	-2,120	+35,640	+35,640
Nursing.....................	50,444	+15,000	+24,500	+24,500
Public health................	17,970	-995	+505	+505
Allied health................	13,380	+6,106	+6,106	+6,106
Prog. dir. & manpower anal...	4,809	+350	+350	+350
Other.......................	13,515	-5,738	-5,738	-5,738
Subtotal, BHME.............	401,375	+12,603	+61,363	+61,363
National Library of Medicine...	19,979	+302	+1,302	+1,302
Other.........................	10,058	+7,307	+7,307	+7,307
Total, NIH...............	1,443,933	+88,971	+235,731	+220,066

*Reflects pay increases and decreases for funds held in budgetary reserve.

**Reflects comparative transfer of $23,000,000 for the salary components of research training grants in health professions schools from the Institutes to the Bureau of Health Manpower Education.

NIH-ADPPE
2-25-71

THE PRESIDENT'S 1972 BUDGET

Activity	1971 Column Comparable	1972 Estimate	Change
	(In Thousands)		
Institutes and Research Divisions			
Research grants......................	$663,292	$680,516	+$17,224
Training grants and fellowships.....	159,260*	152,679*	-6,581
Collaborative res.(mostly contracts)	185,916	189,814	+3,898
Intramural research.................	103,853	109,009	+5,156
Other direct operations............	50,294	51,291	+997
Special cancer initiatives..........	--	100,000	+100,000
Subtotal, IRD's....................	1,162,615	1,283,309	+120,694
Bureau of Health Manpower Education			
Medical, dental and related health professions................	336,897*	421,548*	+84,651
Nursing.............................	74,944	68,018	-6,926
Public health.......................	18,475	18,514	+39
Allied health.......................	19,486	26,494	+7,008
Program direction & manpower anal...	5,159	6,227	+1,068
Other...............................	7,777	7,015	-762
Subtotal, BHME.....................	462,738	547,816	+85,078
National Library of Medicine..........	21,281	21,486	+205
Other................................	17,365	17,803	+438
Total, NIH.........................	1,663,999	1,870,414	+206,415

*Reflects a comparative transfer in each year of $23,000,000 from the Institutes to the Bureau of Health Manpower Education for the salary components of research training grants awarded to health professions schools.

NIH-ADPPE
2-25-71

SUMMARY OF APPROPRIATIONS, 1970-71, AND PRESIDENT'S BUDGET, 1972

National Institutes of Health

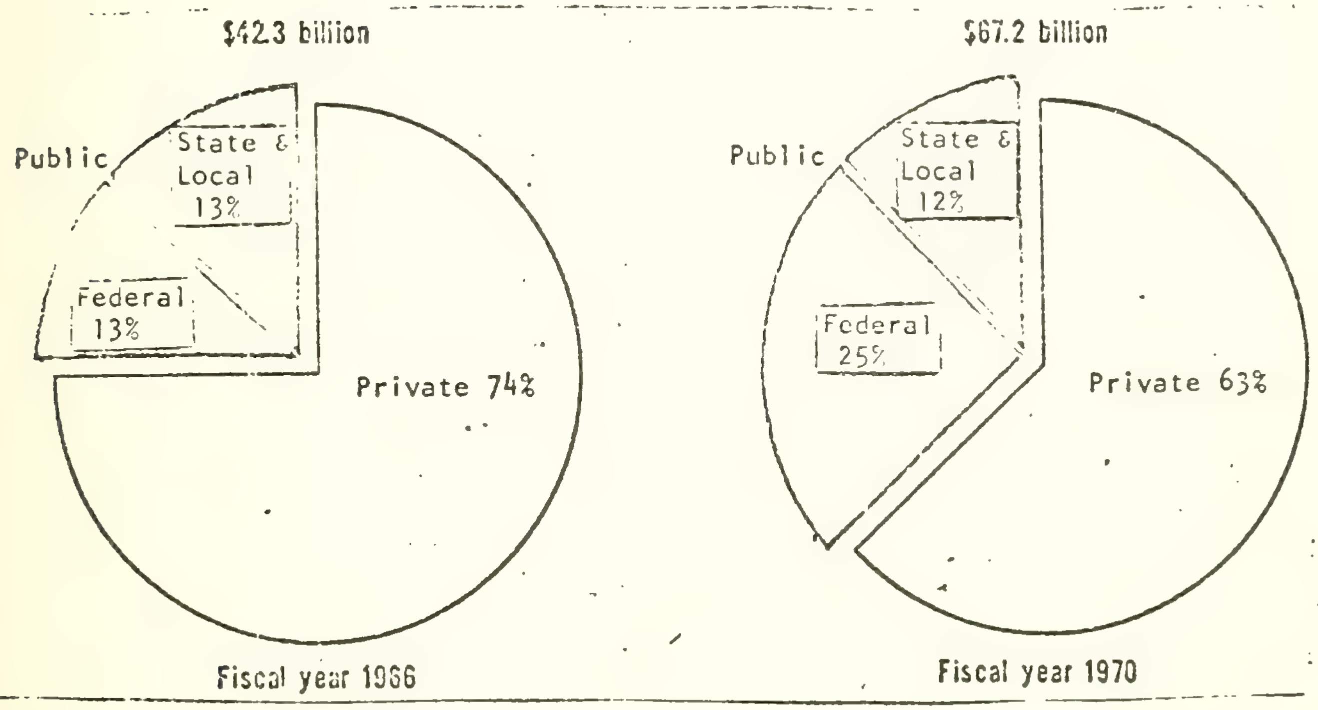
(Amount in millions)

Component	1970 Actual	1971 President's Budget	1971 Cong. Appropriation (comparable)	1972 President's Budget	Increase 1970/72
Subtotal, IRD's	$1,012.5	$1,100.5	$1,178.3	$1,283.3	$270.8
Cancer	179.0	202.4	229.6	232.2	53.2
Heart	156.7	171.7	191.2	194.4	37.7
General medical sciences	142.9	148.4	160.7	150.1	7.2
Arthritis	128.4	132.2	135.8	134.4	6.0
Neurology	92.7	97.0	102.6	95.5	2.8
Allergy	94.1	99.2	98.8	98.4	4.3
Child Health	75.4	93.3	94.0	102.5	27.1
Dental	28.3	34.6	34.9	38.4	10.1
Eye	24.2	25.7	31.5	32.4	8.2
Environmental health	17.2	19.9	20.6	25.0	7.8
Biologic standards	7.8	8.6	8.6	8.6	0.8
Fogarty center	3.2	2.7	3.7	3.3	0.1
Research resources	62.7	65.0	66.4	67.9	5.2
Cancer research initiative				100.0	100.0
Total, NIH	$1,443.9	$1,509.[illegible]	$1,694.6	$1,889.5	$445.6

DISTRIBUTION OF PRIVATE AND PUBLIC HEALTH EXPENDITURES

BY TYPE OF EXPENDITURE

FISCAL YEAR 1970

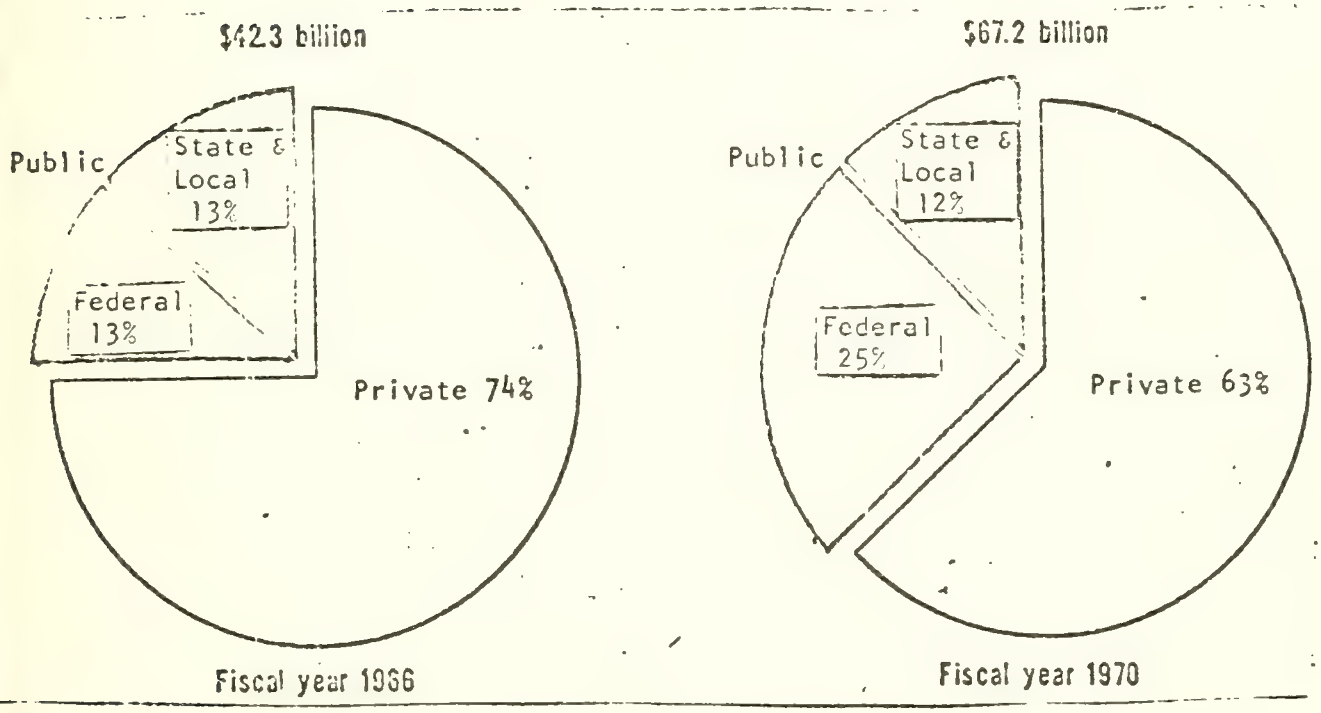


ADPPE-NIH
2/71

DISTRIBUTION OF PRIVATE AND PUBLIC HEALTH EXPENDITURES

BY TYPE OF EXPENDITURE

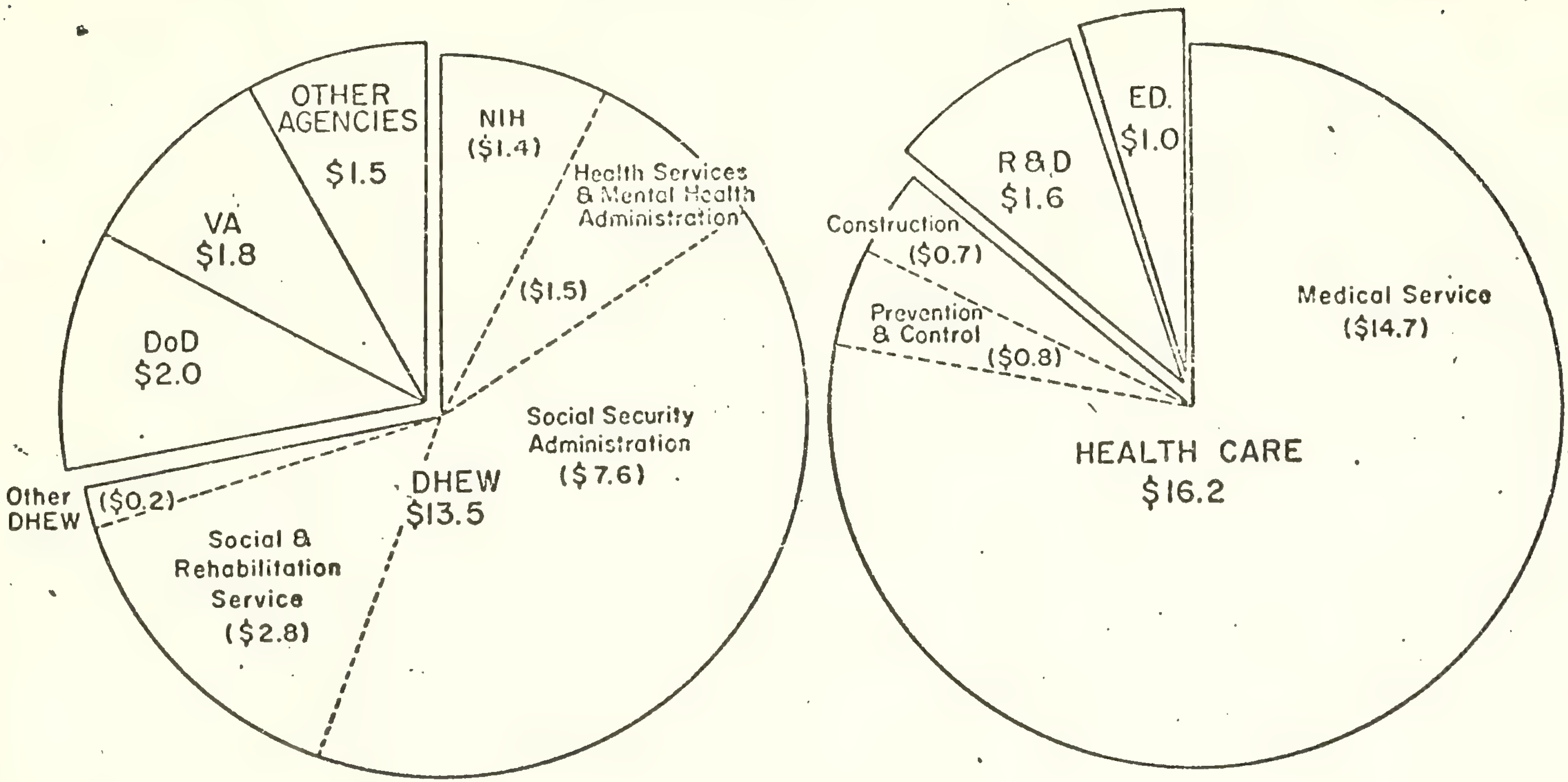
FISCAL YEAR 1970



ADPPE-NIH
2/71

FEDERAL HEALTH EXPENDITURES

$18.8 BILLION, FY 1970 EST.



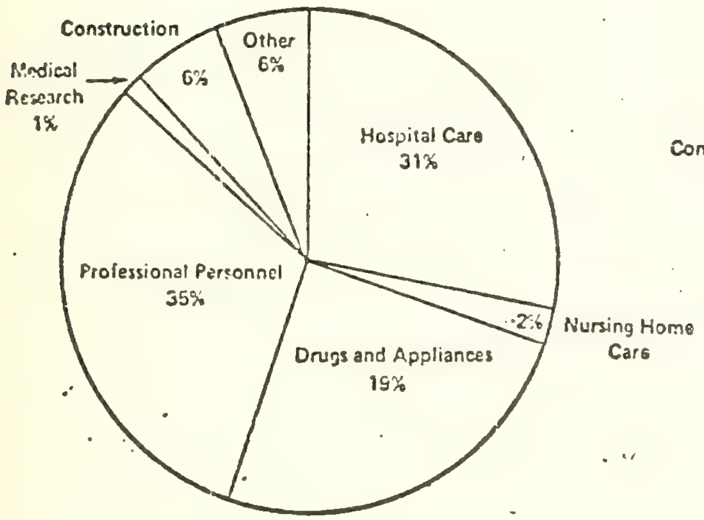
By Agency   By Program

DISTRIBUTION OF PRIVATE AND PUBLIC HEALTH EXPENDITURES

BY TYPE OF EXPENDITURE

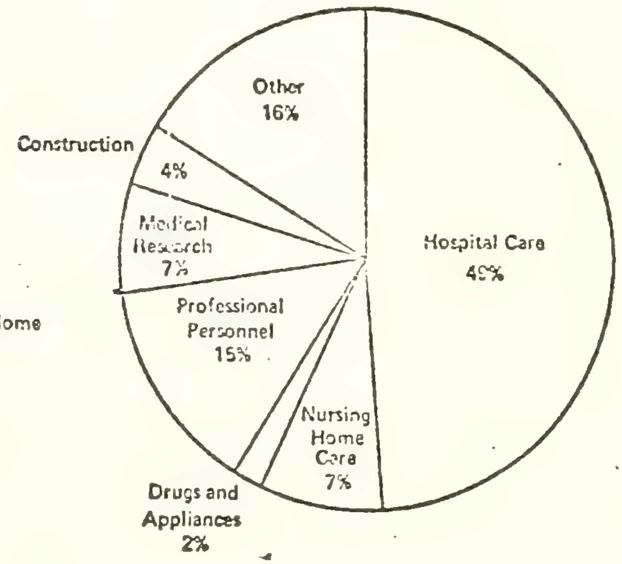
FISCAL YEAR 1970

Private Expenditures



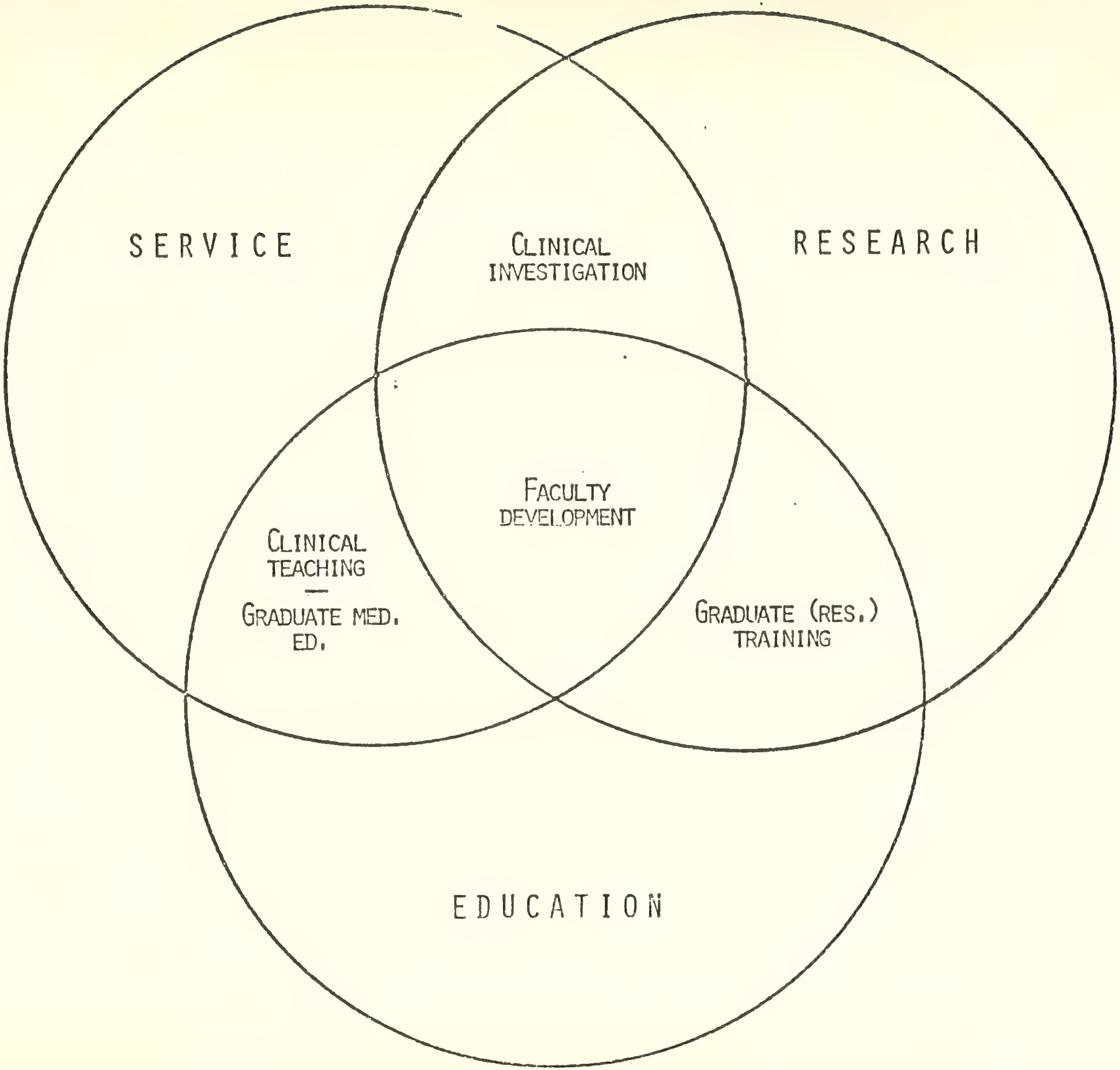
Total $42.3 billion

Public Expenditures



Total $25.0 billion

ADPPE-NIH
2/71


SERVICE
CLINICAL INVESTIGATION
RESEARCH
FACULTY DEVELOPMENT
CLINICAL TEACHING
—
GRADUATE MED. ED.
GRADUATE (RES.) TRAINING
EDUCATION

THE MISSION OF NIH

TO ADVANCE HEALTH AND WELL-BEING THROUGH SUPPORT OF—

- RESEARCH (1) TO PROVIDE A BETTER PRODUCT FOR THE HEALTH CARE SYSTEM TO DELIVER

  (2) TO REDUCE COSTS THROUGH DEFINITIVE SOLUTION OF HEALTH PROBLEMS

- MANPOWER TO OPERATE THE HEALTH-CARE DELIVERY SYSTEM

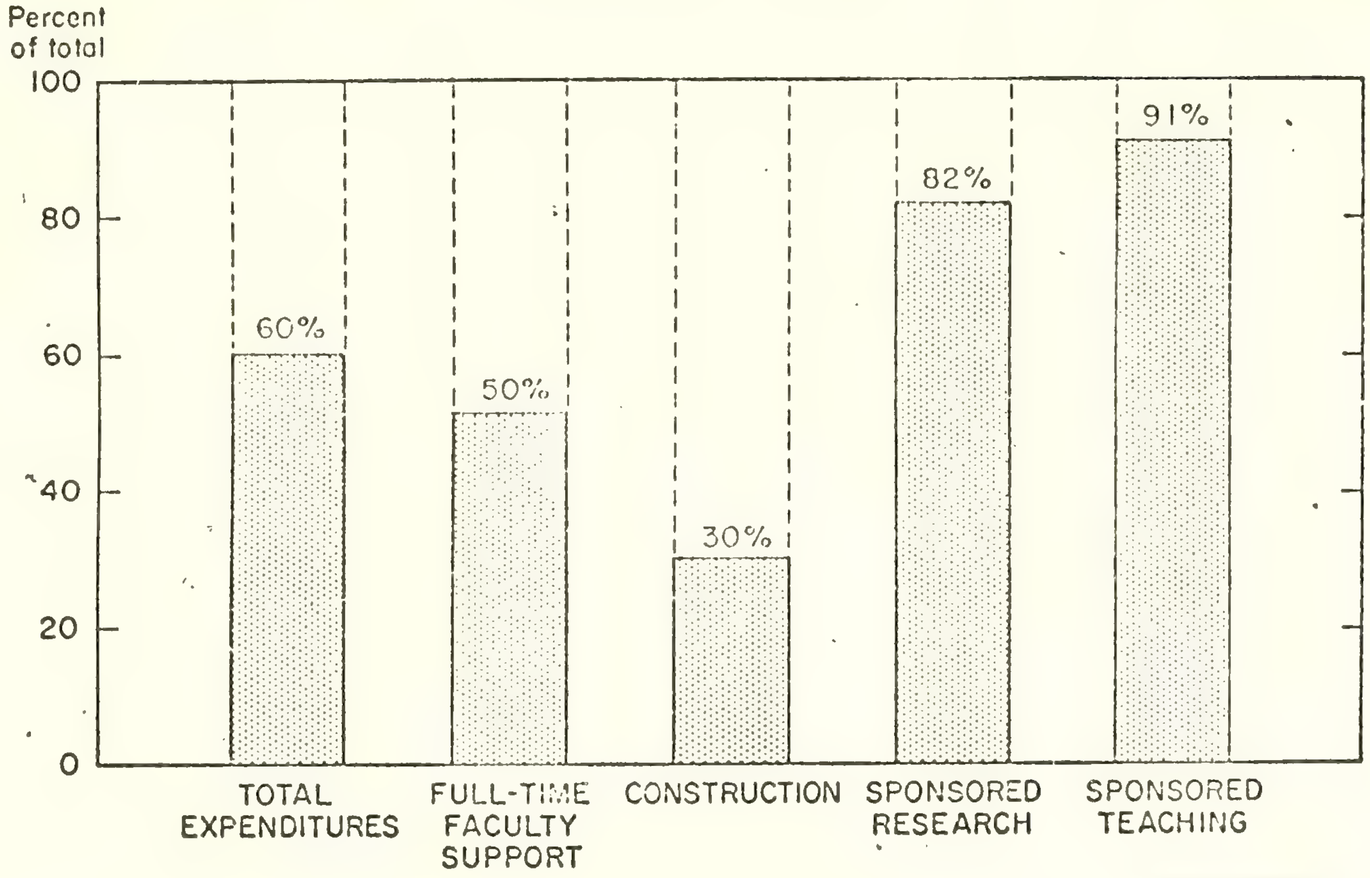
- INSTITUTIONS TO SUSTAIN THE FACILITIES FOR PRODUCING KNOWLEDGE AND MANPOWER

- COMMUNICATIONS TO PROVIDE THE OPERATORS OF THE HEALTH-CARE DELIVERY SYSTEM WITH RAPID ACCESS TO NEEDED INFORMATION

Sources of Support for Medical Schools
(in thousands)

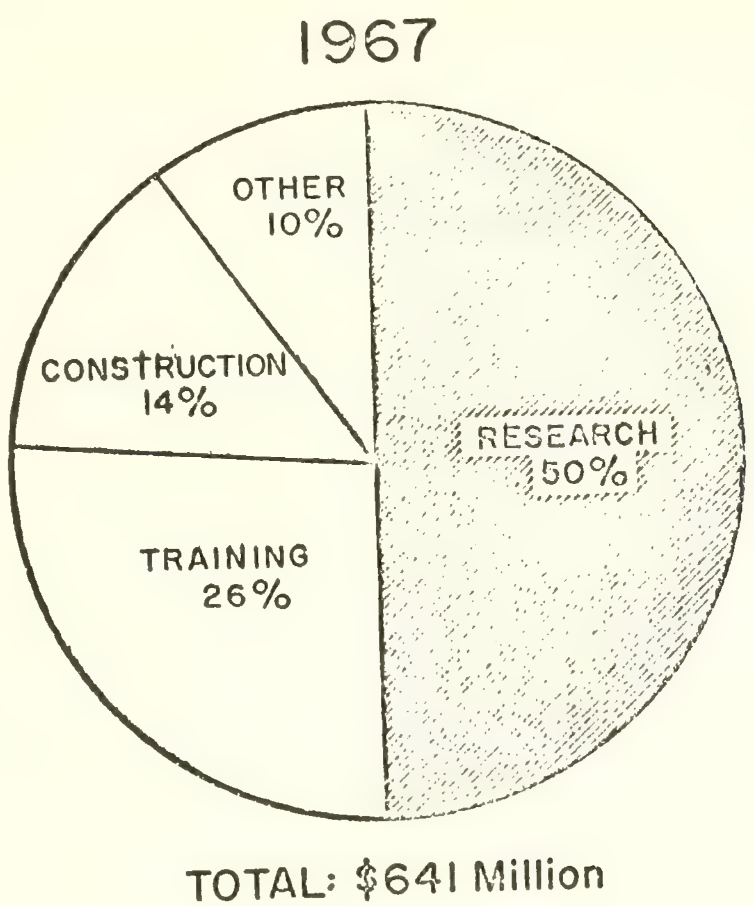
	1958-59 $	1958-59 %	1967-68 $	1967-68 %	1968-69 $	1968-69 %
<u>Sponsored Programs</u>						
Federal Contracts and Grants for Teaching, Service, Research and Training	94,900	30	544,745	46	633,304	46
(NIH)	(94,000)	(29)	(501,165)	(43)	(587,826)	(43)
State and Local Government Contracts and Grants for Research	2,855	1	13,135	1	12,101	1
Other Non-Federal Support	46,483	15	127,328	11	145,138	11
<u>Regular Operating Programs</u>						
Indirect Costs on Federal Contracts and Grants	-		74,452	6	83,863	6
Tuition and Fees	24,368	7	48,252	4	51,968	4
State Appropriations	49,779	15	142,946	12	169,531	13
Unrestricted Endowment Income	17,577	6	29,618	3	31,991	2
All Other	83,067	26	195,788	17	238,158	17
TOTAL	319,029		1,176,264		1,366,054	

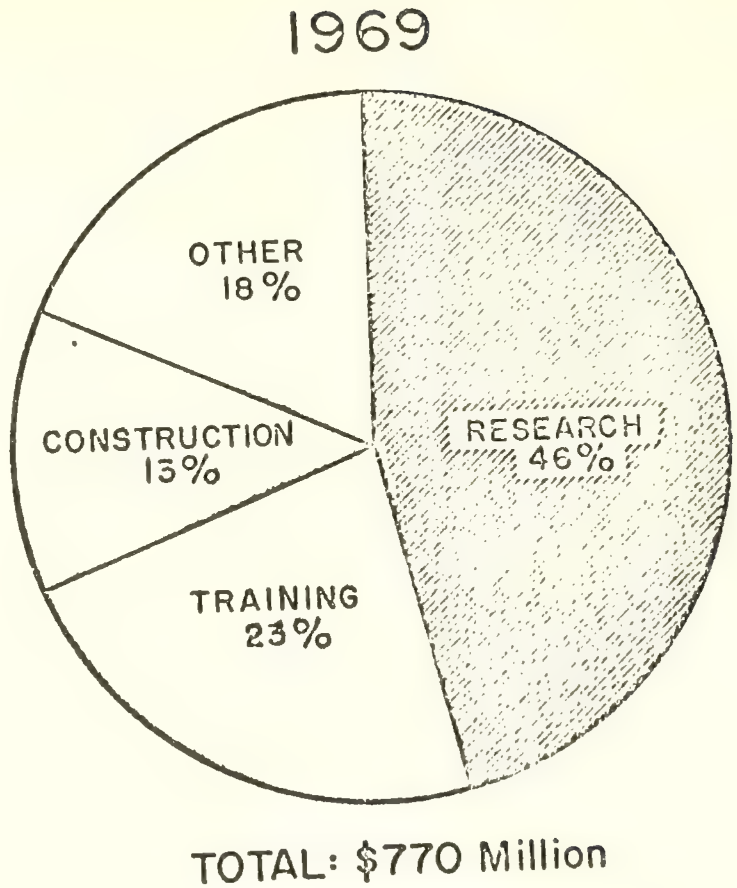
Federal Support as a Proportion of Total Medical School Budgets, by Type, Fiscal Year 1967



RAB-OPPE-NIH
October 1968

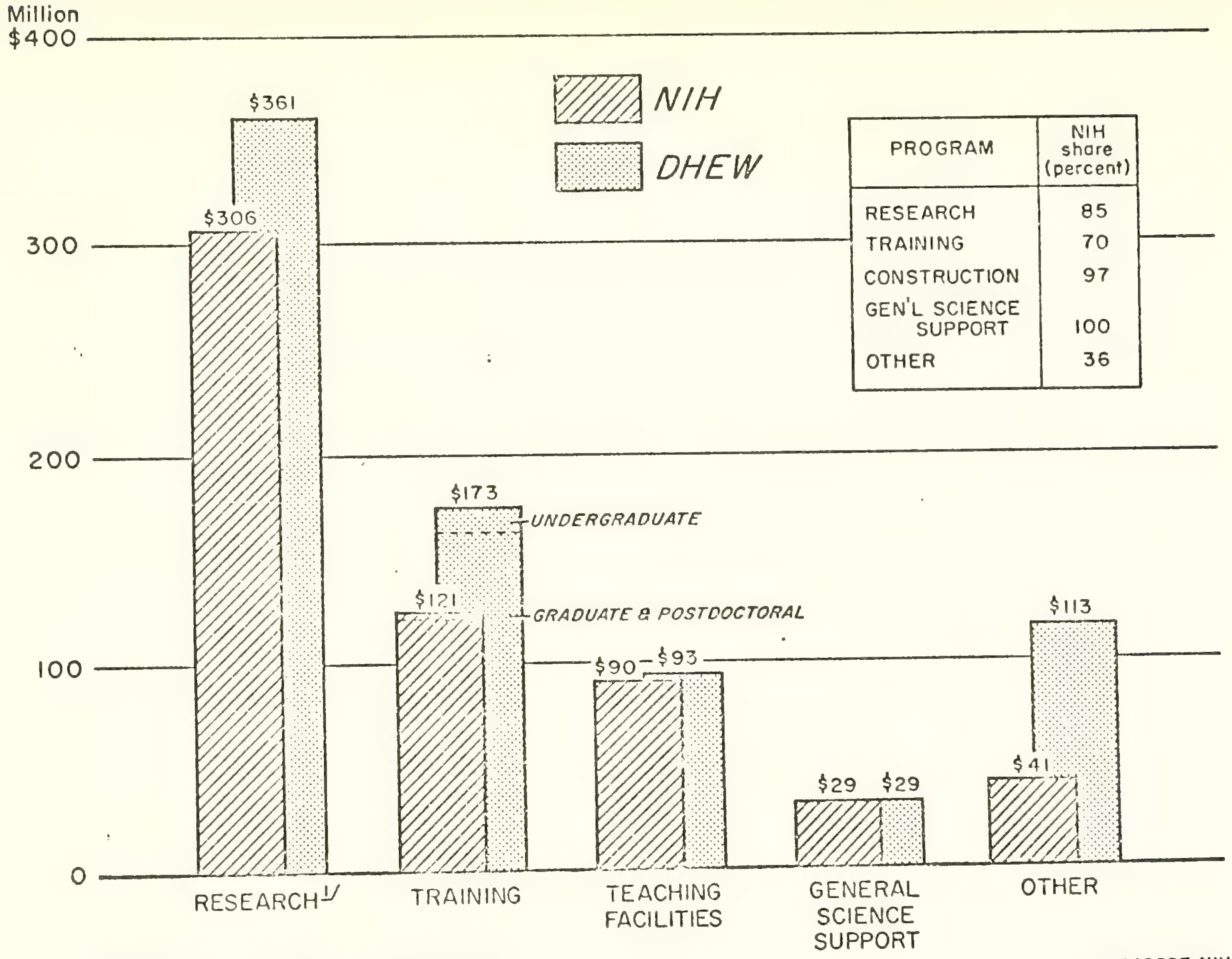
OBLIGATIONS FOR RESEARCH AS A PROPORTION OF TOTAL DHEW SUPPORT TO MEDICAL SCHOOLS, 1967 AND 1969





ORA-OADPPE-NIH
December 1970

NIH OBLIGATIONS TO MEDICAL SCHOOLS AS A PROPORTION OF TOTAL DHEW SUPPO 1969

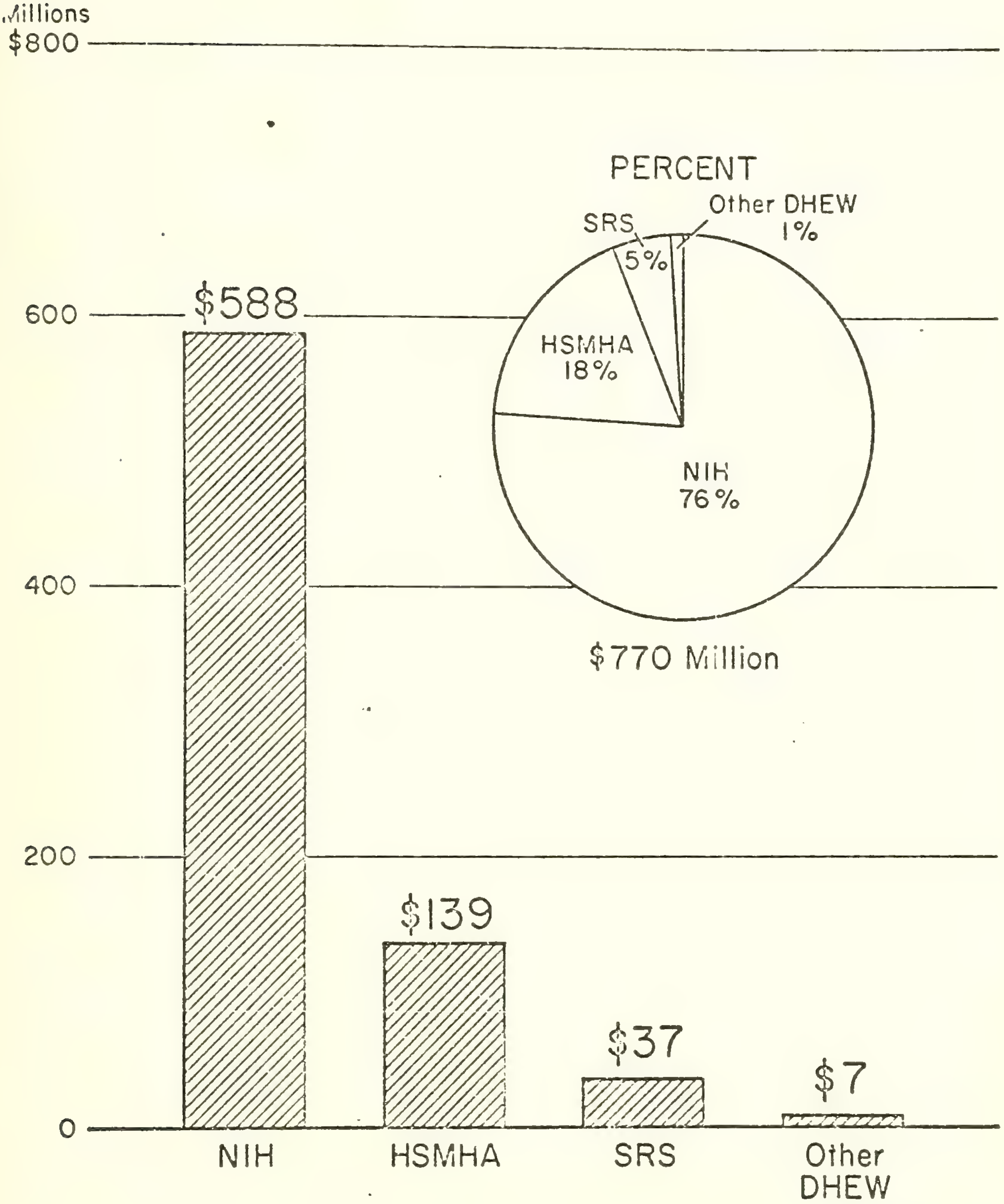


PROGRAM	NIH share (percent)
RESEARCH	85
TRAINING	70
CONSTRUCTION	97
GEN'L SCIENCE SUPPORT	100
OTHER	36

1/ Includes construction of research facilities.

ORA-OADPPE-NIH
December 1970

DHEW OBLIGATIONS TO MEDICAL SCHOOLS, BY AGENCY, 1969



ORA-OADPPE-NIH
December 1970

#661

MEMORANDUM FOR THE RECORD: February 25, 1971

The following material was used by this office to prepare Vugrafs and Xerox copies for Dr. Kennedy's presentation at the AD HOC Advisory Group on Simulation Models, Feb. 25, 1971 at the Linden Hill. Title of meeting: "The Role of the NIH in Fostering the Application of Systems Analysis to Academic Medical Centers." Nickname "ORA Meeting." Meeting to continue thru Feb. 26, 1971. (Note: Sue Fremeau has the originals.)

Title	Source
DHEW Obligations to Medical Schools, by Agency and Program, 1969 (Table)	Publication "DHEW Obligations to Medical Schools, FY 67-69" produced by ORA.
DHEW Obligations to Medical Schools, by Program, 1969 (Table)	"
Obligations for Research as a Proportion of Total DHEW Support to Medical Schools, 1967 & 1969 (Chart)	"
DHEW Obligations to Medical Schools for Support of Research, 1947 & 1967-1969	"
Distribution of DHEW Support to Medical Schools by Agency, 1967 & 1969 (Chart)	"
3 Pie Chart on Service, Research & Education	Special Projects Branch
NIH Obligations to Medical Schools as a Proportion of Total DHEW Support, 1969 (Chart)	Publication "DHEW Obligations to Medical Schools, FY 67-69" produced by ORA.
DHEW Obligations to Medical Schools, by Agency, 1969 (Chart)	"
DHEW Obligations to Medical Schools, by State, 1969 (Chart)	"

SEE ATTACHED

DHEW OBLIGATIONS TO MEDICAL SCHOOLS, BY AGENCY AND PROGRAM, 1969

(Thousands)

Type of support	Total DHEW	Health activities				SRS	Other DHEW
		Total	NIH	HSMHA	CPEHS		
Total	$770,391	$729,929	$587,505	$139,183	$3,241	$36,824	$3,638
Research	361,535	347,451	306,227	38,612	2,612	13,995	89
R&D conduct	355,725	341,641	300,417	38,612	2,612	13,995	89
R&D plant	5,810	5,810	5,810	-	-	-	-
Training (graduate & post-doctoral)	162,128	157,604	118,885	38,110	609	4,[illegible]26	98
Training grants	125,342	123,087	87,211	35,279	597	2,233	22
Fellowships	36,786	34,517	31,674	2,831	12	2,193	76
Undergraduate training grants and scholarships	11,327	8,503	2,309	6,194	-	2,650	174
Construction[1]	93,417	91,915	90,541	1,374	-	1,502	-
General science support	28,623	28,623	28,623	-	-	-	-
Other	113,361	95,833	40,920	54,893	20	14,251	3,277

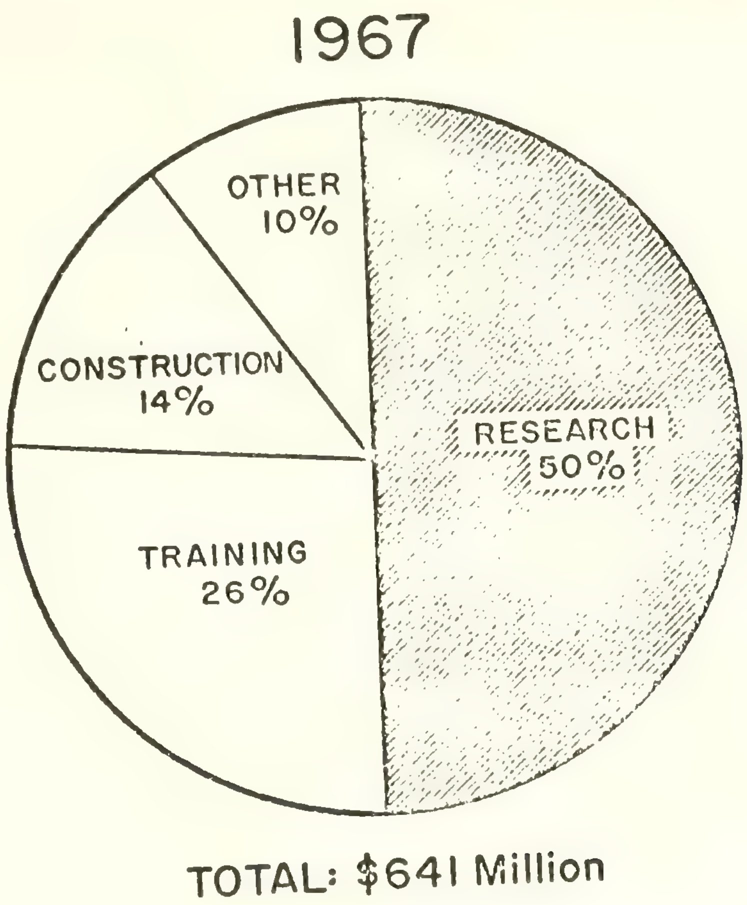
[1]Teaching and related facilities.

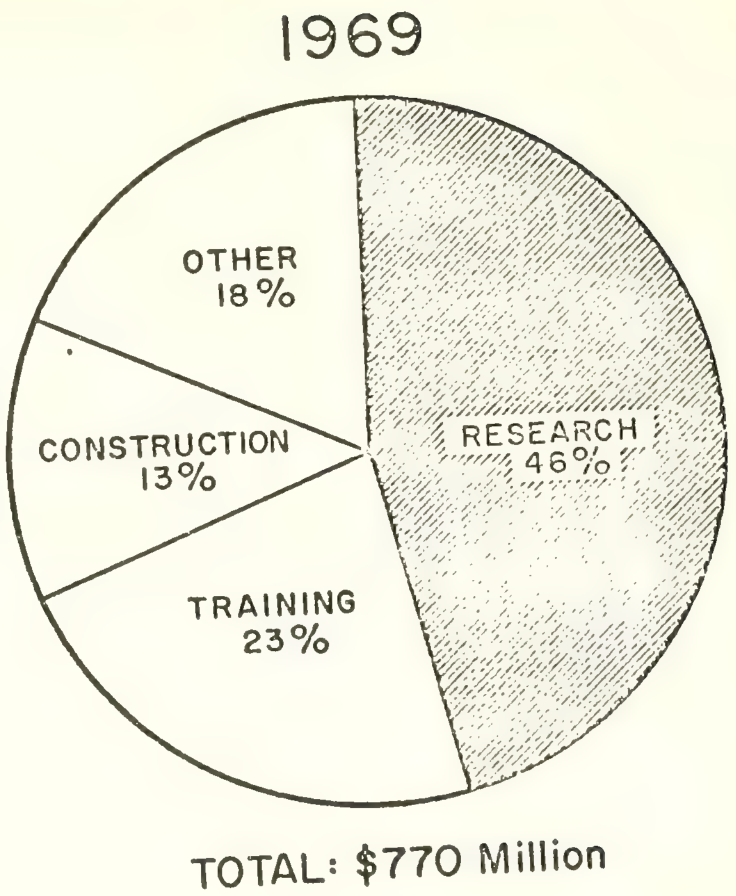
DHEW OBLIGATIONS TO MEDICAL SCHOOLS,
BY PROGRAM, 1969

Type of support	Amount (millions)	Percent distribution
Total	$770.4	100.0
Research	361.5	47.0
R&D conduct	355.7	46.2
R&D plant	5.8	0.8
Training (graduate and postdoctoral)	162.1	21.0
Training grants	125.3	16.3
Fellowships	36.8	4.8
Undergraduate training grants & scholarships	11.3	1.2
Construction 1/	93.4	12.1
General science support	28.6	3.7
Other	113.4	14.7

1/ Teaching and related facilities

OBLIGATIONS FOR RESEARC S A PROPORTION OF TOTAL DHEW
SUPPORT TO MEDICAL SCHOOLS, 1967 AND 1969





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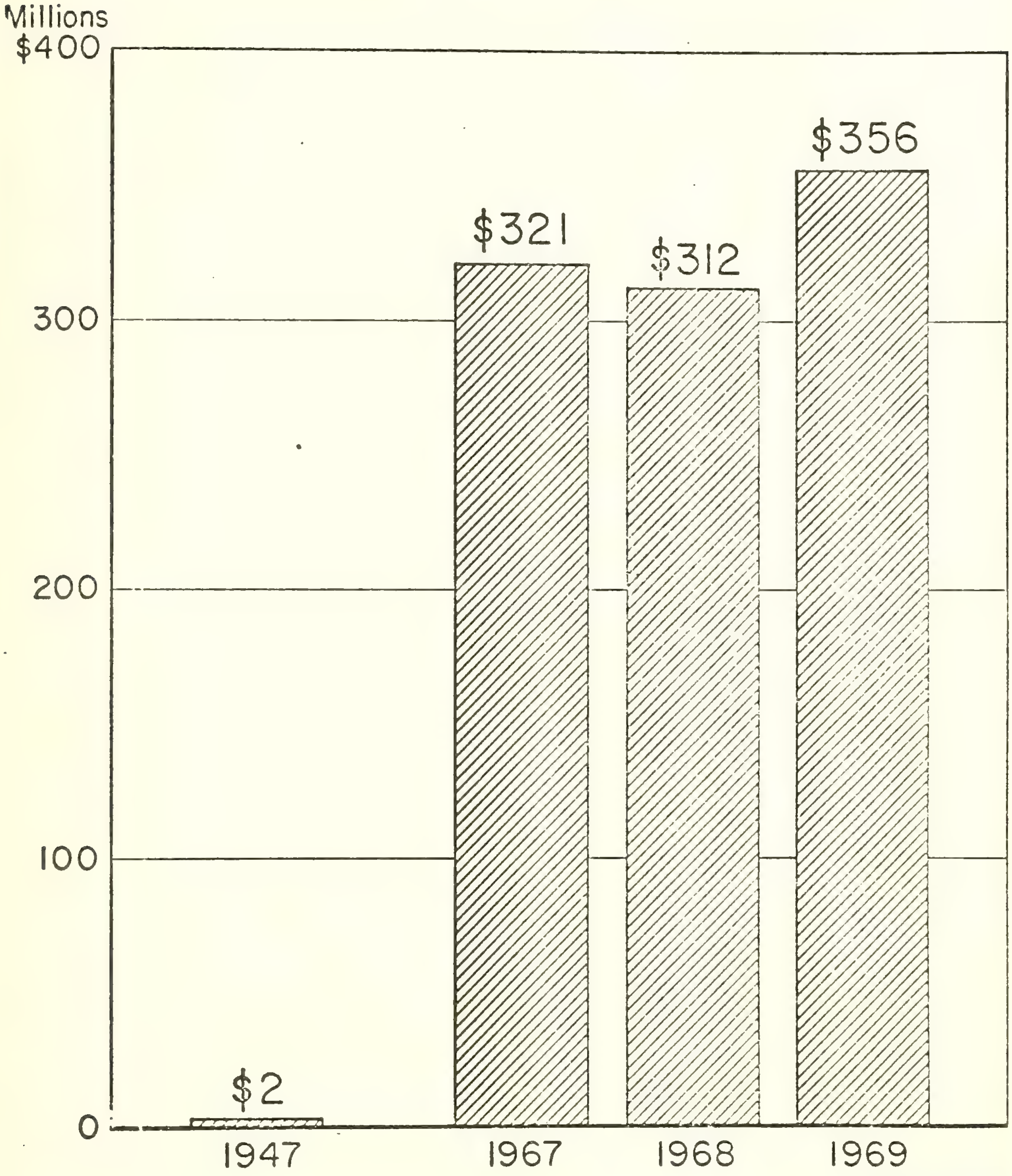
DHEW OBLIGATIONS TO MEDICAL SCHOOLS FOR SUPPORT OF RESEARCH, 1947 AND 1967-1969



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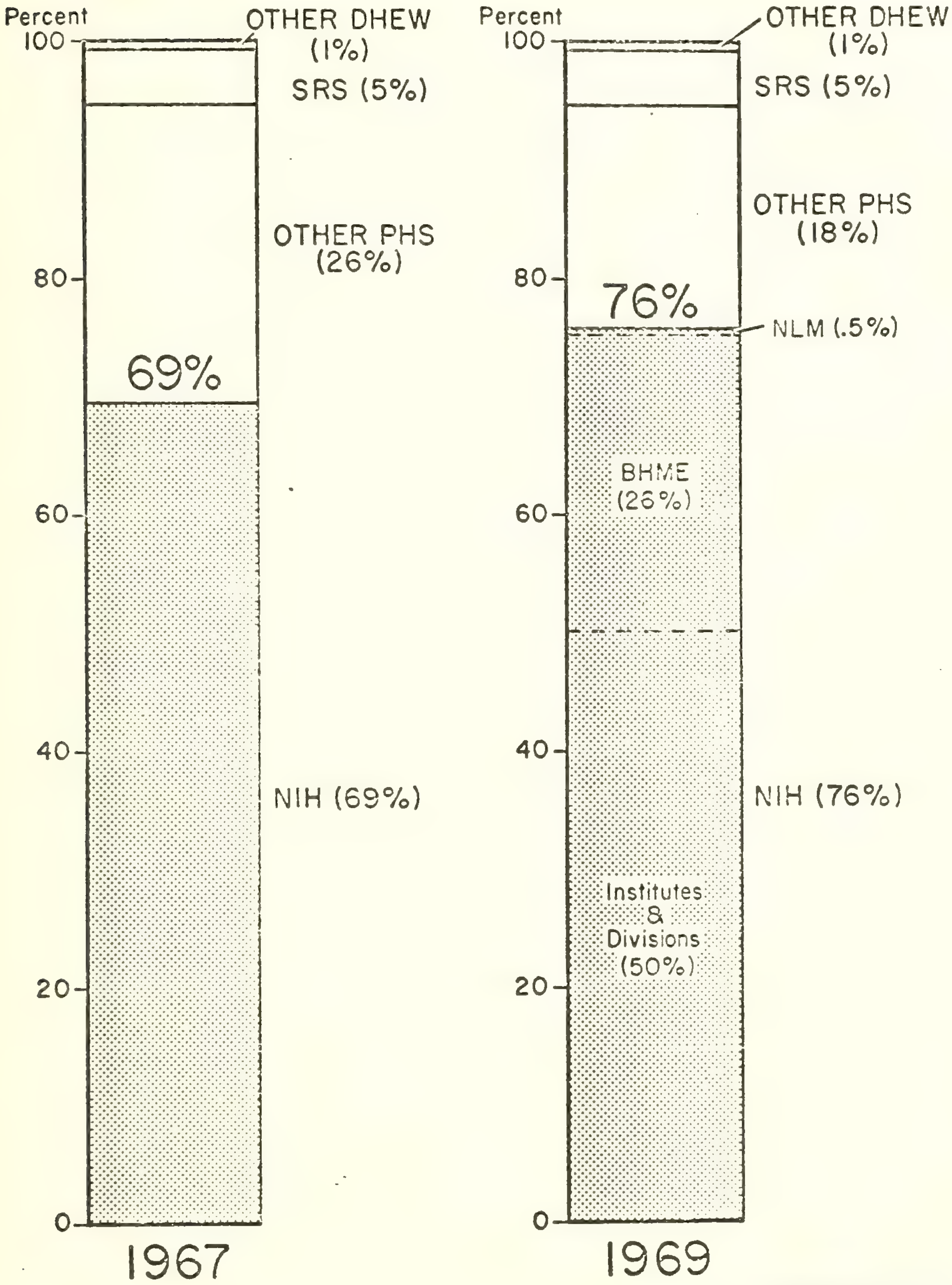
DISTRIBUTION OF DHEW SUPPORT TO MEDICAL SCHOOLS BY AGENCY, 1967 AND 1969



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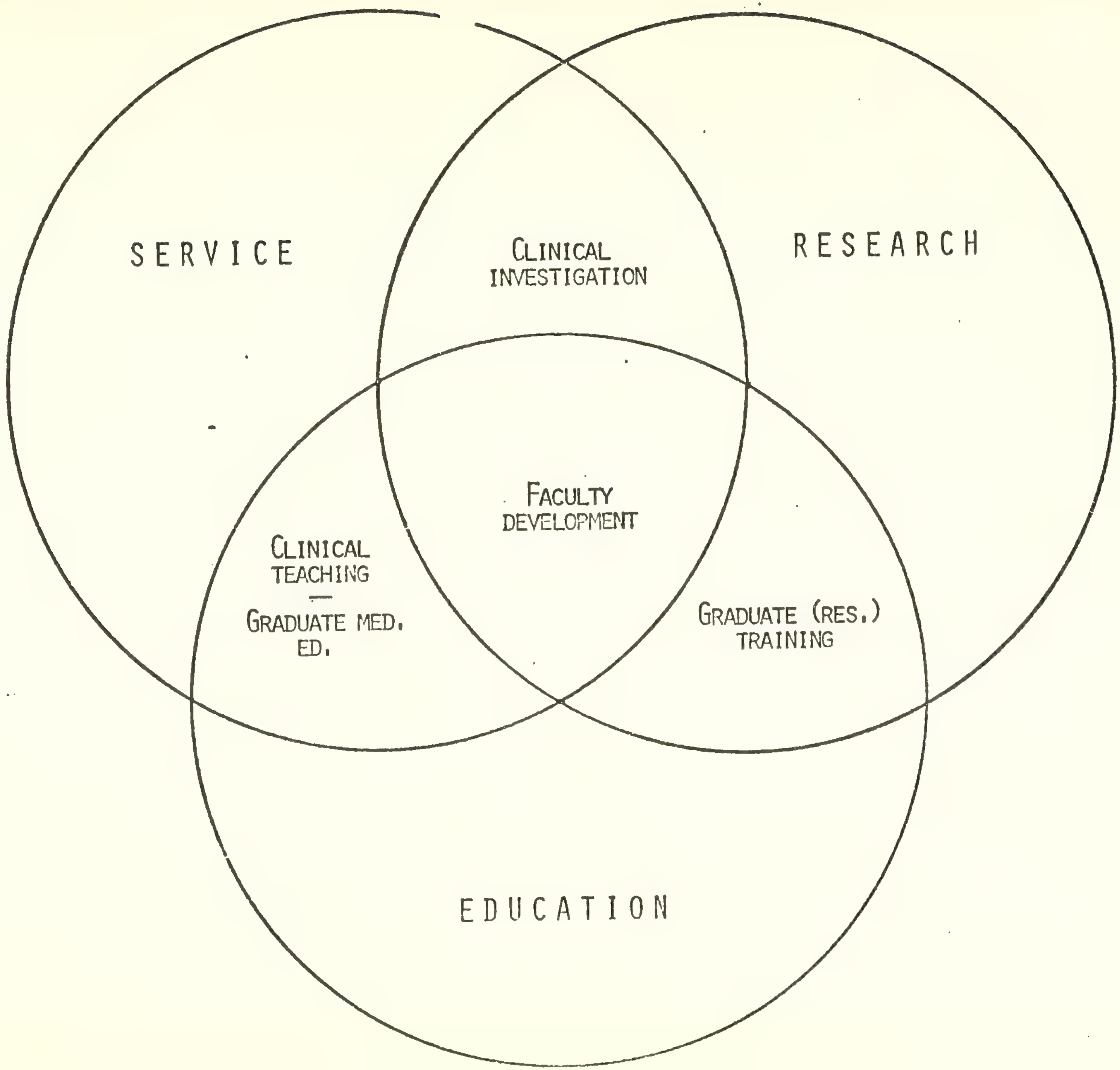
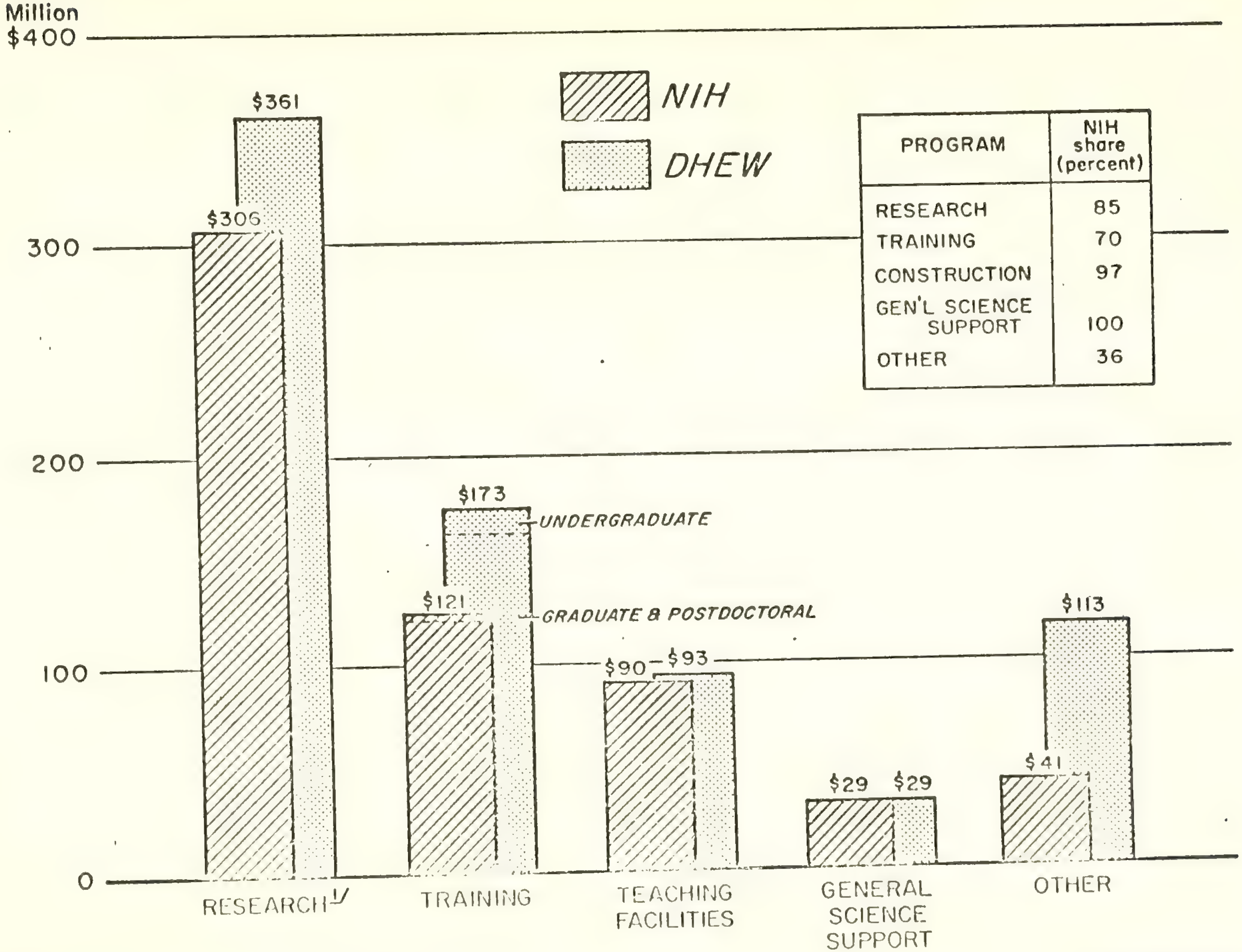

SERVICE
CLINICAL INVESTIGATION
RESEARCH
FACULTY DEVELOPMENT
CLINICAL TEACHING
GRADUATE MED. ED.
GRADUATE (RES.) TRAINING
EDUCATION

NIH OBLIGATIONS TO MEDICAL SCHOOLS AS A PROPORTION OF TOTAL DHEW
SUI RT, 1969



1/ Includes construction of research facilities.

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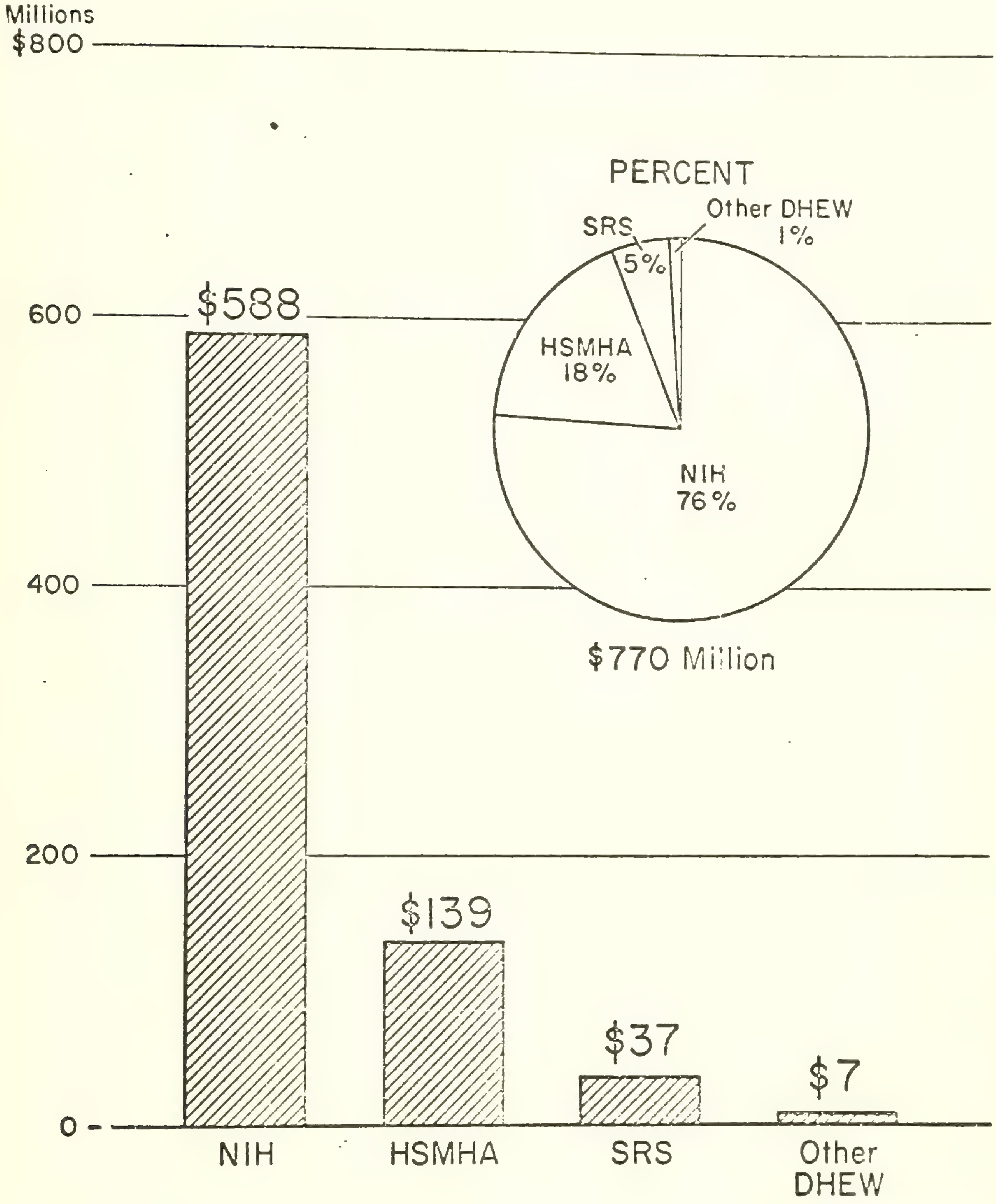
DHEW OBLIGATIONS TO MEDICAL SCHOOLS, BY AGENCY, 1969



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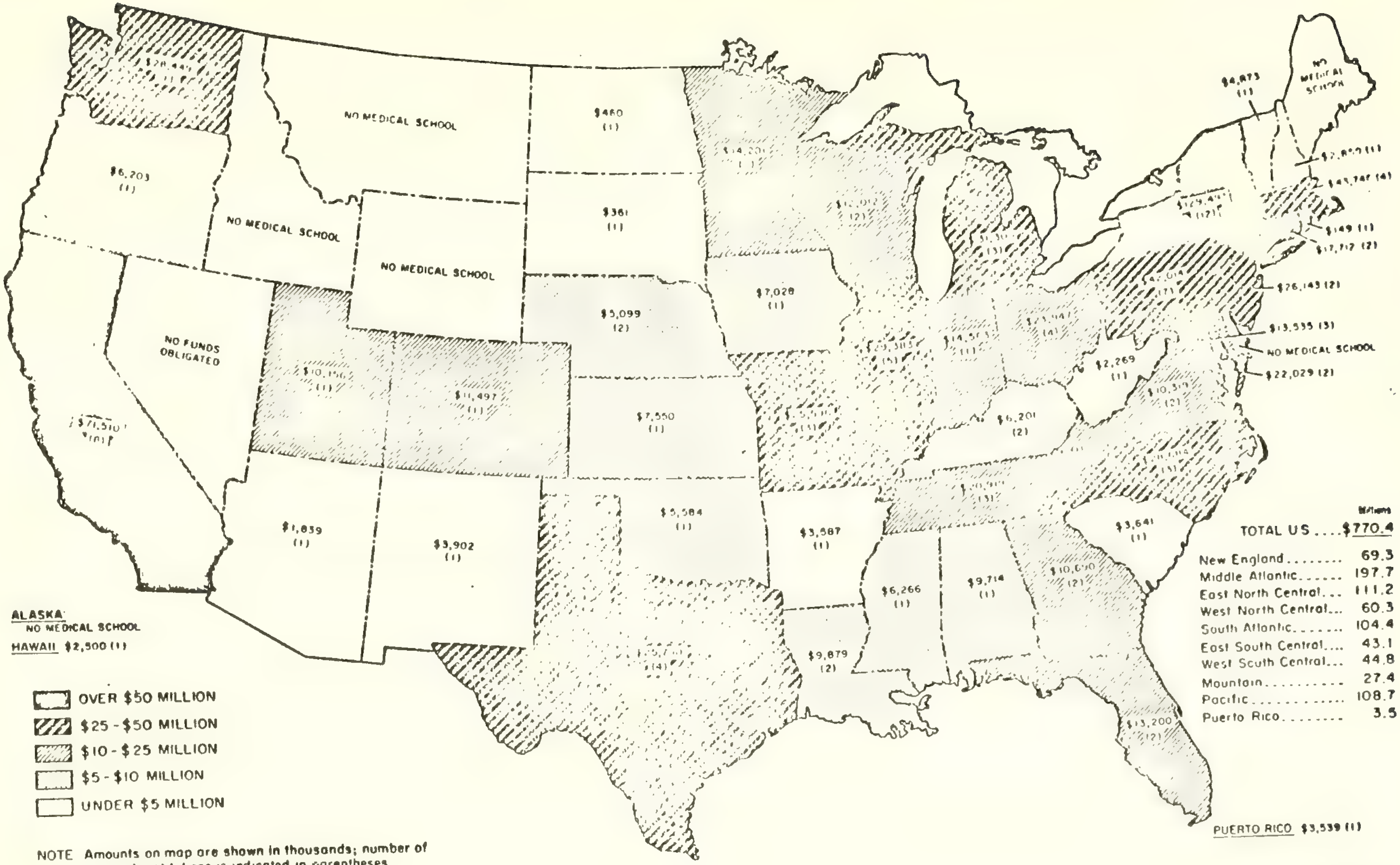
DHEW OBLIGATIONS TO M′ CAL SCHOOLS, BY STATE, 1969



	Millions
TOTAL US	$770.4
New England	69.3
Middle Atlantic	197.7
East North Central	111.2
West North Central	60.3
South Atlantic	104.4
East South Central	43.1
West South Central	44.8
Mountain	27.4
Pacific	108.7
Puerto Rico	3.5

NOTE Amounts on map are shown in thousands; number of recipient institutions is indicated in parentheses.

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TAB 4

MAY 13 1971

ACADEMIC SCIENCE SUPPORT PROGRAMS OF THE NATIONAL INSTITUTES OF HEALTH *

Thomas J. Kennedy, Jr., M.D.

To provide a background for the discussion on the contribution of the National Institutes of Health to the support of academic science, I should like first to sketch very briefly the main features of recent trends in Federal support to academic institutions. For this purpose I shall make use of transparencies which I believe will convey quickly and clearly the points I wish to make.

Growth of Federal Support to Academic Institutions, 1963-1967

Between 1963 and 1967 Federal obligations for both science and non-science purposes increased rapidly -- from $1.4 billion to more than $3.0 billion (ILLUSTRATION 1). These five years witnessed major changes in Federal programs, reflecting the impact of new legislation as well as expansion and improvement of existing programs.

Several forces influences this growth --

- o An increased demand for higher education;
- o The emergence of a national consensus on the acceptance of a new Federal role in higher education;
- o The proliferation of new social programs in the mid-1960's; and
- o Strong Presidential encouragement of academic science.

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*Presented before the Advisory Committee for Planning, National Science Foundation, May 14, 1971.

The Apparent End of Expansion, 1967-1970

The rapid rate of growth which characterized this period did not, however, continue into the last years of the decade. Beginning with 1967, fiscal constraints imposed by the Vietnam War, Executive efforts to curb inflation, and shifting program priorities resulted in a levelling-off in the rate of growth of Federal obligations to academic institutions. Indeed, between 1969-70 Federal support actually declined by almost $260 million -- from a peak level of $3.5 billion in 1969 to about $3.2 billion in 1970.

Federal Support of Academic Science

Academic science (indicated by the heavy curve) also experienced a period of relatively rapid growth between 1963-1967 with Federal obligations for this purpose rising from $1.3 billion to $2.3 billion. Since 1967, however, support for science has reflected the total Federal pattern of decelerated growth and -- most recently -- of moderate decline. Yet, it is important to note that these developments have been attended by an expansion in support from other sources, notably State governments. (Taking into account all sources of financial support, total expenditures for academic science increased 7 and 3.5 percent, respectively, between 1968-69 and 1969-70.)

And as you are aware, the President's Budget for FY 1972 proposes significant increases for academic science. Later, I shall have occasion to refer to the implications of this budget request for NIH and its programs of academic support.

Growth of Non-Science Activities

I should perhaps point out that since 1964 the rate of growth of the non-science component of academic support has significantly exceeded that of academic sciences (ILLUSTRATION 2). Particular striking increases for these activities occurred in the four years, 1964-1967; thereafter, non-science programs encountered the same budgetary constraints which had inhibited the growth of academic science.

As shown, the pattern of growth of non-science support has clearly paralleled the growth of OE funding of higher education activities. Much of the increase indicated for the Office of Education in 1964-66 was due to the implementation of the Higher Education Act of 1963 which assigned to that agency responsibility for aiding in the construction of new undergraduate and graduate facilities.

The Agency Sources

ILLUSTRATION 3 emphasizes the prominent role of the Department of Health, Education, and Welfare as a prime source of financial support to academic institutions. In all, seven cabinet departments and five other agencies obligate appreciable amounts, although only two departments (DHEW, DOD) and one agency (NSF) administer programs totalling $200 million or more per year.

The emergence of DHEW over the past decade as the primary source of support to academic institutions has been due principally to the expansion of the Department's activities in health fields (largely through programs of NIH) and in higher education (through OE). The rather striking increase in DHEW support during 1964-1967 (ILLUSTRATION 4) is primarily attributable to the swift growth in magnitude and diversity of OE programs under legislation enacted by the 88th and 89th Congresses.

Through its multi-faceted programs of academic support, the Department has contributed to the strengthening of the Nation's structure for higher education and to the building of a broadly-based, vigorous, and world-renowned national system for biomedical research.

THE NIH POSITION

The National Institutes of Health occupies a special position as the largest single source of support to academic institutions (ILLUSTRATION 5). This agency now accounts for half of the DHEW total and a third of all Federal support at academic institutions. In FY 1970 NIH contributed over $1 billion* for research, training, construction, and general support of operations. Through the magnitude and scope of its operations in the academic

* Includes non-science activities.

setting, NIH has become the principal determinant in the making of medical research policy and exercises a powerful influence on the realization of the Nation's health goals.

Fiscal History of NIH Programs, 1960-1970

The growth of NIH over the past decade is reflected in its budget history (ILLUSTRATION 6). May I quickly run through the stub-entries of interest: Extramural program obligations, which constitute a comprehensive measure of current operating support to grantee institutions and long-range capital investment in both people (through training grants and fellowships) and in space (through research facilities construction grants); obligations for academic science, including research, training, and facilities awards to academic institutions; and as a subset of these, awards to medical schools by the Institutes and Research Divisions of NIH, and the combined NIH/NIMH data for 1960-1969.

In ILLUSTRATION 7 the major elements have been selected and normalized to reflect FY 1960 = 100. The general patterns of growth are discernible here: steady and positive growth for most program categories through 1967-68 and a levelling or decrease thereafter. Program levels for 1970 do not differ materially from those recorded for 1967.

The chart (ILLUSTRATION 8) depicts this pattern graphically. 1968 is shown to be the peak year for the total NIH extramural programs, with research accounting for three-quarters of the total. Particularly evident is the rise and fall of the research facilities construction program which exhibited steady growth through 1965 and a precipitate decline thereafter.

The Impact of Inflation

In ILLUSTRATION 9 the total growth in program expenditures has been further refined through application of the GNP deflator to cover simple price inflation. The data presented here clearly identify some of the major causes for concern in the biomedical community. While the total budget for extramural research, measured in current dollars, has levelled off, the actual amount of research, measured in constant dollars, has declined since 1968. Similarly, support for academic science has also dropped in real terms -- from $600 million in 1968 to $495 million in 1970 (although a moderate increase is anticipated for 1971).

The course of real program levels are reflected in the following table and chart (ILLUSTRATIONS 10 and 11) where constant dollars have been normalized to FY 1960. As shown in ILLUSTRATION 11, real growth in (1) medical school academic science support, and (2) academic science, outpaced growth of the NIH extramural programs and the total NIH budget.

Other inflationary factors beyond those reflected in simple GNP deflator have been: differentially high faculty salary growth (in part a consequence of more rapid escalation of professional income of practicing physicians), growth in hospitalization costs, and increasing complexity and sophistication of instrumentation and equipment (ILLUSTRATIONS 11a-11e).

In consequence of the deceleration of real growth in agency support, the academic community has been experiencing considerable difficulty in absorbing the effects without disruptions of a major nature. Although the impact has varied with individual institutions, it has been estimated that constraints on Federal spending coupled with general inflation and other special factors have resulted in a 25 percent reduction in the program level of biomedical research since the funding peak of 1967-68.

The Institutes of NIH

The relative emphasis of NIH categorical program support may be deduced from current appropriations data of individual institutes and the President's 1972 budget (ILLUSTRATION 12).

A total of $1.2 billion was appropriated in FY 1971 for NIH Institutes and Research Divisions. These funds support a wide diversity of research and training activities aimed at disease categories and the promotion of health. The most heavily funded programs include cancer, heart, general medical sciences, arthritis, allergy, and neurology.

Major increases for the 1970-72 period are reflected in the appropriations of (a) the National Cancer Institute, especially for viral carcinogenesis studies and the separately budgeted Cancer Initiative; (b) the Heart and Lung Institute, especially for investigations related to atherogenesis; (c) the National Institute of Child Health and Human Development, especially for the program on population and family planning; (d) the National Institute of Dental Research, especially for work on caries; and (e) the National Eye Institute and the National Institute of Environmental Health Sciences to get their embryonic programs off the ground.

ILLUSTRATION 12A identifies the specific areas of program emphasis. Beyond the special initiative areas I have just mentioned -- cancer, child health, dental health, environmental health, heart disease -- are the continuing basic programs in allergy and infectious diseases, arthritis and metabolic diseases, neurological diseases and stroke, and the general medical sciences.

[illegible] period the NCI budget [illegible]
NHLI & NEI increased by about 12% [illegible]
[illegible]
The budgets [illegible] institutes (NIGMS, NIAMD [illegible]
and NIAID [illegible] 2-3% per year [illegible]
[illegible] constant dollars.

Of paramount importance, however, is the special, targeted attack on cancer announced by President Nixon in his State of the Union message last January, and elaborated in his public statement on Tuesday. The "Cancer-Cure Program", as presently envisaged, will remain in the National Institutes of Health but will be independently funded and operate under a director who will report directly to the President. Much of the actual research will be performed extramurally, under contract, at academic institutions and at other research facilities throughout the Nation.

The broad classes of program activity are summarized in ILLUSTRATION 13. I shall only take a moment to highlight the significant changes: Indicated is a substantial increase of $88 million for the research grants program between 1970-72; funds for fellowships are slightly reduced, while those for training grants are at approximately the same level in FY 1970 and 1972. Collaborative R&D, a subset of "Direct Operations", describes work usually undertaken at the initiative of the Government, generally through research contracts, and frequently awarded to non-academic performers. The very substantial increase of $63 million between 1970-72 represents the emphasis on research in viral oncology

and in family planning, population control, and contraceptive technology. These are areas in which academic institutions have much to contribute, and it is hoped that they will compete for use of these funds.

For NIH as a whole, the President's FY 1972 Budget provides an increase of nearly $450 million over the FY 1970 level. This increase has presented NIH with unusual opportunities and unusual problems. Among the questions now being explored are --

- The effect on the balance of NIH's overall mission of the relatively uneven distribution of the budget increases;
- The probable distribution of the additional funds among grantee institutions; and
- The impact of the increases on the institutions and their activities.

MEDICAL SCHOOLS

Most of these funds are, of course, expended in the academic setting, and NIH support at academic institutions continues to be broadly based and pervasive. In 1970 NIH awarded funds to almost 600 colleges and universities throughout the Nation as a means of discharging its health missions.

Included in its programs of academic support are all of the Nation's existing medical schools, as well as 12 medical schools in development.

And here perhaps I should pause to say a few words about the critical role of NIH and DHEW in support of the Nation's medical schools. These institutions represent an appreciable fraction of total Federal funds obligated at colleges and universities -- almost a fourth; the DHEW contribution now accounts for well over nine-tenths of the Federal total and constitutes more than half of the medical schools' total expenditures.*

Research and Training

Research continues to comprise the largest single segment of DHEW support to medical schools, accounting for almost half the total (ILLUSTRATION 14). However, support for research has exhibited a somewhat uneven pattern of growth in the last four years, dipping in 1968 below the level reported for the previous year, and dropping again in 1970 below the level reported for 1969. This pattern reflects a more general tendency characteristic of the growth of total Federal R&D support in the recent period.

* Estimate based on annual accounting of medical schools to AAMC and the AMA Council on Medical Education. Data do not include total medical center outlays, e.g., hospitals.

As shown, DHEW obligations for training purposes increased gradually between 1967-1970. Recently, efforts have been underway to assess the impact of these programs. A National Academy of Sciences study of training programs sponsored by the National Institute of General Medical Sciences was concluded in 1969, and an intensive agency review covering basic aspects of the program is now in progress.

Expanding Health Resources

Support for research and training, of course, accounts for the larger part of the NIH extramural program -- as it has for the past two decades. The last few years, however, have witnessed a shifting emphasis of agency support away from these "traditional" support categories to other, newer programs. For example, NIH efforts in 1967-1970 were increasingly aimed at the problem of augmenting national health care resources -- primarily physician manpower -- and in improving arrangements for delivery of health care (ILLUSTRATION 15). These programs include financial aid to medical schools and other health professional schools for construction of teaching facilities, direct support for institutional operating costs, and limited undergraduate aid through scholarships and loans to low-income students.

The Current Plight of Medical Schools

Despite moderate growth of overall DHEW support to medical schools in recent years, more than half these schools are now experiencing severe financial difficulties; many have applied for and have received interim assistance -- "distress grants", if you will -- from the Department. Retrenchment appears to be an immediate prospect for many schools, and a few institutions have indicated the possibility of discontinuing operations altogether.

Numerous factors have contributed to this unfortunate situation -- declining endowment income, increasing graduate enrollments, leveling of support for research, burgeoning costs of MEDICARE and MEDICAID, student disorders, and, in some instances, unfavorable actions of State legislatures.

I cannot tell you now how long this period of uncertainty will last. Clearly, a prolonged projection of the current situation would threaten all our major national health objectives.

CHANGES AND TENDENCIES

(ILLUSTRATION 16) For the remainder of the time alloted to me I should like to consider, very briefly, some of the changes and tendencies of recent years and a few of the problems and issues which concern us at NIH.

Organizational Changes

For NIH and DHEW the past few years have been a period of reorganization and consolidation. Under the reorganizations of 1968 (ILLUSTRATION 17) the former Bureau of Health Manpower and the National Library of Medicine were incorporated into the National Institutes of Health; two new agencies -- the Health Services and Mental Health Administration and the Consumer Protection and Environmental Health Service were created, combining all other functions assigned to the Public Health Service (segments of CPEHS have recently been incorporated into the newly organized Environmental Protection Agency). Of particular significance for NIH was the broadening of its responsibilities to embrace activities relating to medical education and training, responsibilities now centered in the Bureau of Health Manpower Education (BHME). In short, as a result of this organizational change, our mandate now involves support of education as well as research.

Shifting Emphasis to Health Services

(RETURN TO ILLUSTRATION 16). A second important tendency which has affected our thinking and planning has been the new national interest and emphasis accorded the health services. For the next few years the

problem of marked concern about our whole health service system will inevitably complicate the picture of support for academic science. Medical schools are deeply involved, not only as producers of manpower, but because their teaching hospitals also constitute the main source of biomedical research.

The new emphasis on health care has already resulted in a fundamental shift in the distribution of the health dollar (ILLUSTRATION 18). Ten years ago roughly two-thirds of the Federal health dollar was devoted to medical research and research training; about a tenth was spent on personal health services for the general population. In 1970 health service funding rose to about 60 percent of the Federal total. Health service financing programs have been the fastest growing segment of the Federal health dollar.

Strengthening Academic Science

(RETURN TO ILLUSTRATION 16). Support for academic science will continue to have a high priority in the current administration, as indicated by the President's Budget for 1972. This budget proposes significant increases in research funds to colleges and universities -- between 9 and 12 percent -- more than compensatory for the year's inflation.

These increases will be subsidized by the Administration's new expansionary full-employment budgetary policy.

Targeted Programs

Of increasing importance, too, has been the highly-targeted program approach to research problems, particularly in areas of cancer, heart, dental health, child health, family planning, and population studies. (ILLUSTRATION 19). I have already mentioned President Nixon's unequivocal affirmation of a total national commitment to the conquest of cancer and in the Legislative Branch, action is pending on Senator Kennedy's "Conquest of Cancer Act" (S. 34) which provides for transfer of employees, contracts, property, and resources from the NCI, a component of NIH, to a National Cancer Authority.

Approximately 38 percent of the project contract activity budgeted for 1972 is expected to be performed in the academic setting; however, an increasing share -- 40 percent in FY 1972 contrasted with 37 percent in 1971 -- will be performed in industrial laboratories.

A New View of Training

(RETURN TO ILLUSTRATION 16) In regard to the question of training we anticipate that in the future greater use will be made of the resources of the private credit market to assist individuals and institutions in meeting heavy one-time costs which can be repaid over a period of years. This approach will receive Federal backing through appropriate guarantees and subsidies.

And although I can affirm that NIH is still in the training grant business, I must add that we have not been without a sense of harassment in regard to this program for the past several months. Indeed, since April of last year, a searching study of NIH training programs has been underway in response to a request of the Office of Management and Budget. A preliminary report has been submitted delineating what is necessarily a complex situation. Additional evidence is now being sought to illuminate the whole question of training in the biomedical sciences. It seems almost certain, however, that NIH will continue to rely heavily on the training grant as the most effective support mechanism in meeting biomedical research manpower needs for the future.

PROBLEMS AND ISSUES

In passing, let me mention only a few of the problems and issues which have drawn our attention in recent months and which, I believe, confront all of us involved in science planning (ILLUSTRATION 20).

Uncertainty of Current Situation

The current situation is characterized by continuing fiscal instability at many of the Nation's academic institutions, aggravated by inflation; constraints on Federal funding of academic science activities; growing competition for available resources generated by

unresolved social, ecological, and other issues; and in the field of health the prospect of drastic reorganization of the entire health service system.

Current Difficulties in Long-Range Planning

This framework of uncertainty is necessarily inimical to the long-range planning effort. It is difficult to plan under circumstances where even the most fundamental questions are raised regarding the appropriate relationship of Government and universities, and of the proper role of science in American life.

Nor does there appear to be any consensus on basic issues such as the need for additional scientists and engineers. Health manpower planning, for example, is fairly difficult when no agreement exists on the question of whether there are at present too many or too few physicians or biomedical investigators. We are responsible for the intermediate product, but the final goal -- the number of physicians required at a finite point in time -- is unknown.

Pluralism vs. Centralization

One of the issues to which a vast amount of attention has been given is the perennial one of the centralization of science: the need to reconcile the virtues of a diversity of sources of Federal support and multiplicity of programs with the growing necessity for central policy direction and control of Federal programs within the Executive Branch. Decentralization and pluralism in Federal science are blamed for the chronic weakness of science planning and program coordination in the Federal system; the objection to centralization has been the fear that poor judgment or bias could foreclose the chances of support for some investigators.

NIRAS

A related issue has been the proposal to establish a National Institute of Research and Advanced Studies. As you are aware, considerable discussion has attended the proposal to create NIRAS --the new administrative entity recommended by the Daddario subcommittee last April. Such an agency would include an institute of natural sciences, an institute of education, and an institute of arts, humanities, and social studies. As presently envisaged, it would operate with a budget of more than $2 billion and would be responsible for funding as much as 60 percent of all Federally supported research.

In accordance with the recommendations of the Committee additional study is now being given to the status of the National Institutes of Health in respect to NIRAS. The fact that NIH is essentially a research activity lends weight to the argument for its inclusion in NIRAS; the fact that NIH research is so pointedly a mission-oriented type of research favors the argument against its inclusion. Proponents of NIRAS have not faced the real issue of what distortions would be created in a so-called balanced program by a Manhattan project in cancer or in environmental pollution.

Federal Responsibility for Higher Education

Turning our attention for a moment from science and research to education, we find that in recent years there has been increasing support for the adoption of a policy to define the financial responsibility of the Federal Government for higher education. There appears to be general agreement that the educational institutions of the Nation are in serious financial straits. The question is what form this assistance shall take -- whether to the institutions or to the students, whether the support should be restricted to the sciences or opened to the arts and humanities, and whether it should be in the form of loans or grants.

The New Federalism

Looking ahead, we are witnessing the evolution of a basic realignment of Federal-State-local relations. New concepts of revenue-sharing and welfare reform have been proposed which, if implemented, could have a profound impact on educational financing.

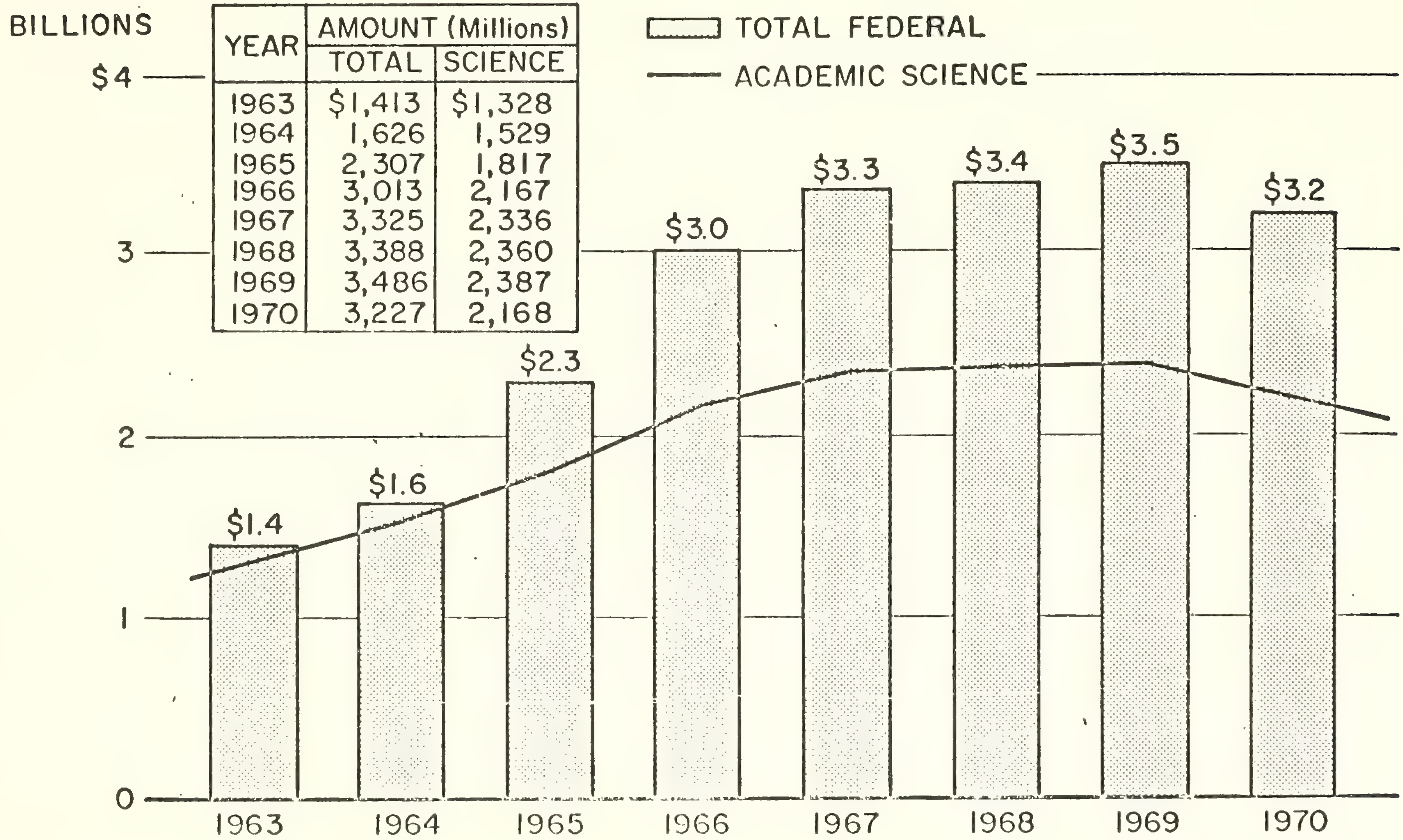
THE TASK AHEAD

The immediate and urgent problem before us, however, is how best to manage the present resources in a period of constrained budgets and at the same time to strengthen the science environment and assure the continued growth and development of the Nation's academic institutions.

Within the limits of statutory authority and fiscal capability, the National Institutes of Health will continue to seek ways and means to improve the effectiveness of existing programs; to provide more stable mechanisms of support; and to reinforce the general capabilities of academic institutions to deal with the increasing challenges and responsibilities thrust upon them by society.

TOTAL FEDERAL OBLIGATIONS TO ACADEMIC INSTITUTIONS AND SUPPORT FOR ACADEMIC SCIENCE, 1963-1970

YEAR	AMOUNT (Millions)	
	TOTAL	SCIENCE
1963	$1,413	$1,328
1964	1,626	1,529
1965	2,307	1,817
1966	3,013	2,167
1967	3,325	2,336
1968	3,388	2,360
1969	3,486	2,387
1970	3,227	2,168



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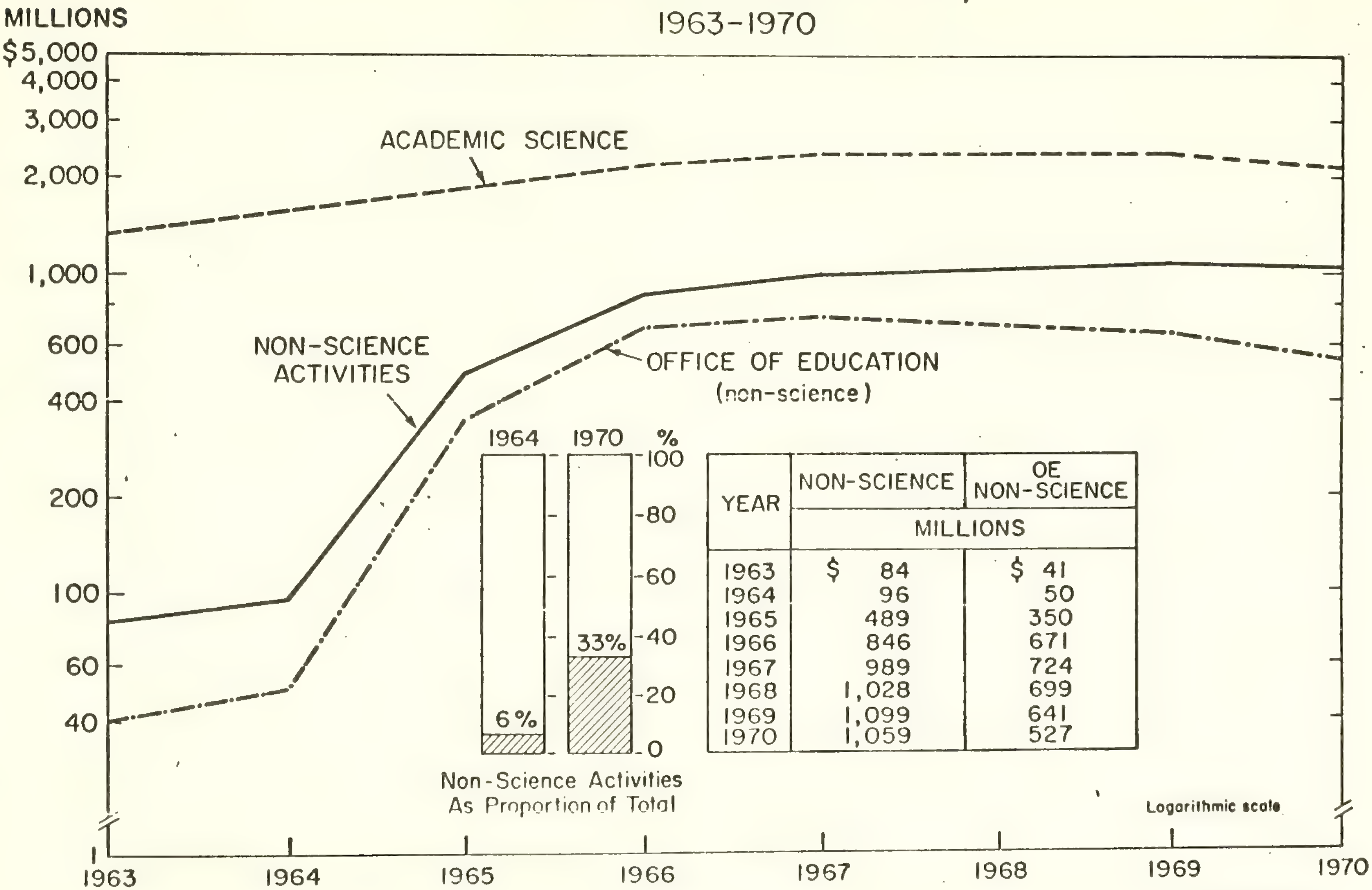
GROWTH OF FEDERAL SUPPORT FOR NON-SCIENCE ACTIVITIES AT ACADEMIC INSTITUTIONS, 1963-1970



YEAR	NON-SCIENCE	OE NON-SCIENCE
	MILLIONS	
1963	$ 84	$ 41
1964	96	50
1965	489	350
1966	846	671
1967	989	724
1968	1,028	699
1969	1,099	641
1970	1,059	527

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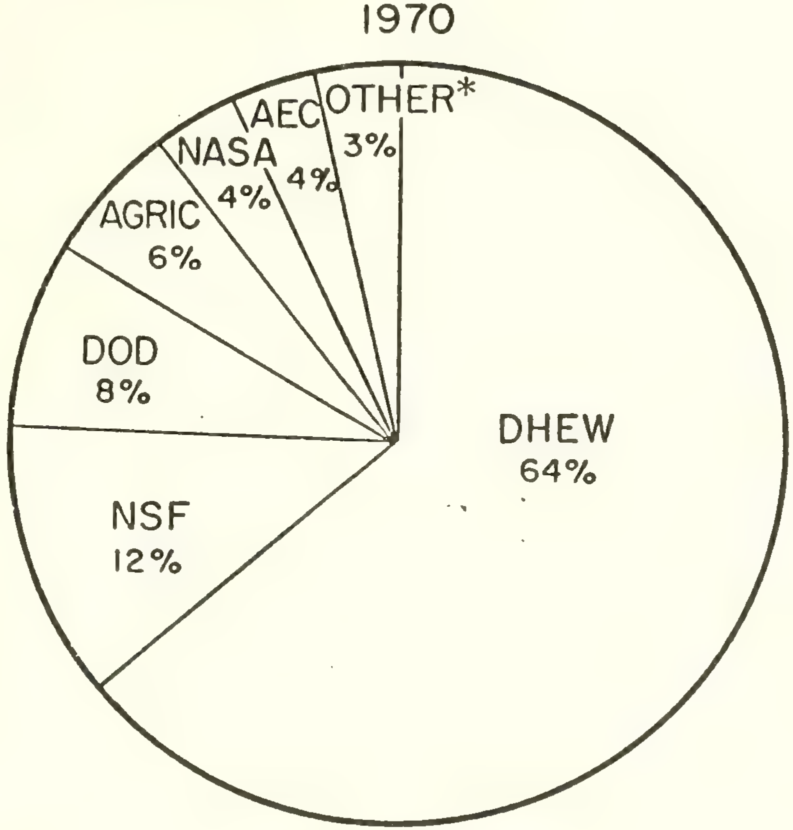
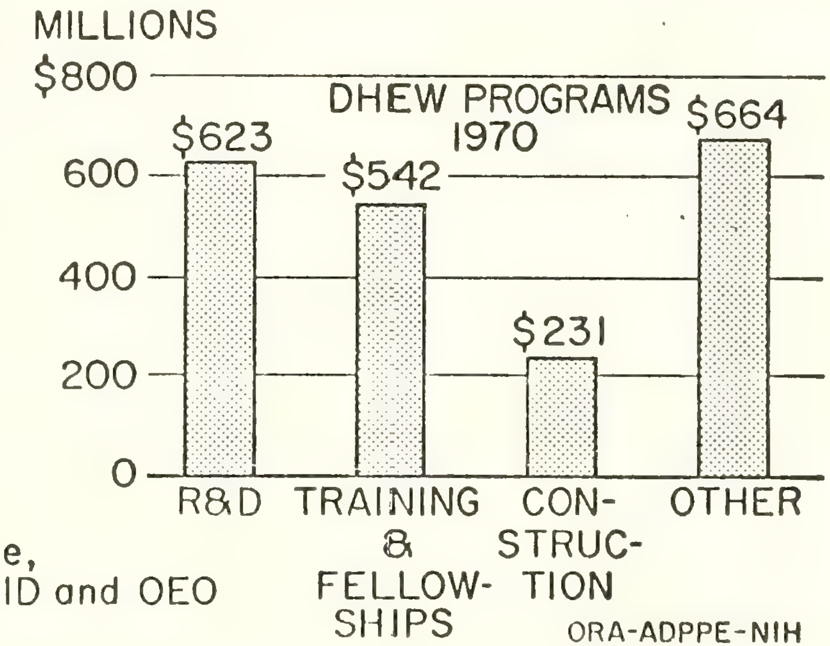
FEDERAL OBLIGATIONS TO ACADEMIC INSTITUTIONS, BY AGENCY, 1970



AGENCY	1969	1970
	Millions	
TOTAL	$3,486	$3,227
DHEW	2,326	2,060
NSF	367	387
DOD	279	266
AGRICULTURE	156	182
NASA	127	131
AEC	121	115
OTHER*	110	86



*Includes Departments of Interior, Commerce, Housing and Urban Development, Labor, AID and OEO

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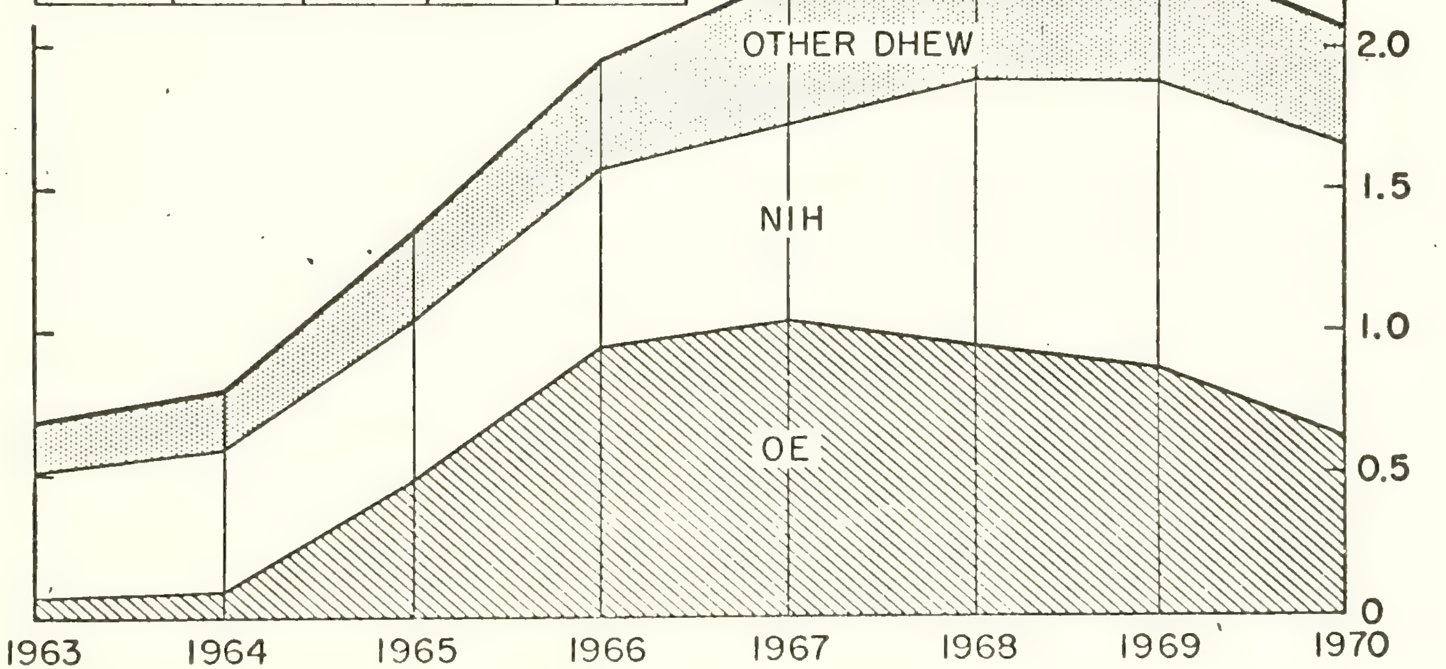
DHEW, NIH, AND OE OBLIGATIONS TO ACADEMIC INSTITUTIONS, 1963–1970

YEAR	AMOUNT (Millions)			
	DHEW	NIH	OE	OTHER
1963	$ 665	$ 442	$ 67	$157
1964	780	498	82	200
1965	1,347	566	472	309
1966	1,956	629	945	382
1967	2,245	702	1,028	516
1968	2,224	943	944	337
1969	2,326	1,016	865	445
1970	2,060	1,030	623	407



Note: 1968-69 increases shown for NIH are primarily a reflection of organizational changes which resulted in absorption of BHME, formerly an independent Bureau within PHS.

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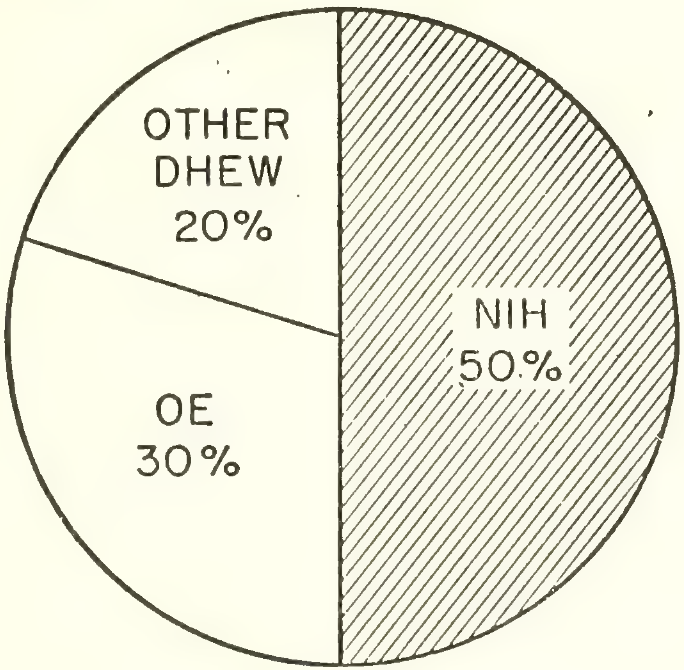
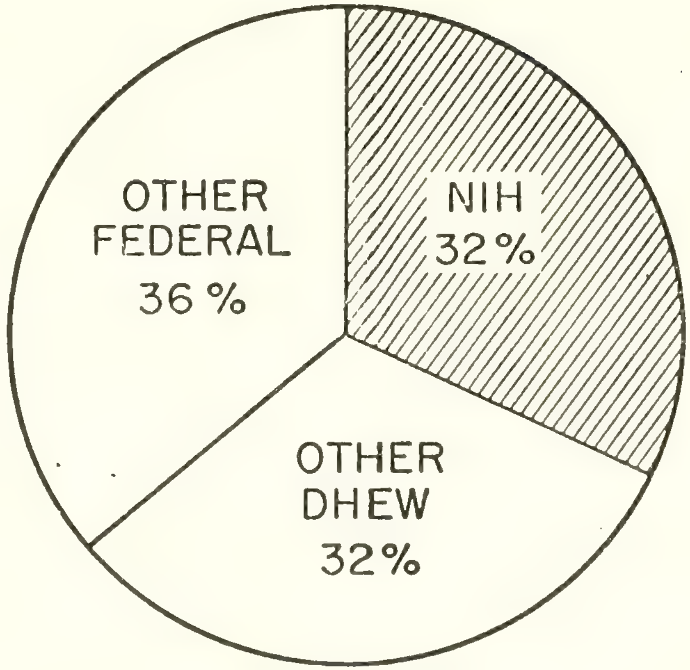
NIH OBLIGATIONS TO ACADEMIC INSTITUTIONS
as a Proportion of (1) Total DHEW and (2) Total Federal Support

1970



TOTAL DHEW
$2,060 MILLION



TOTAL FEDERAL
$3,227 MILLION

ORA-ADPPE-NIH
May 1971

~~TABLE 1~~

NIH OBLIGATIONS FOR VARIOUS BUDGET CATEGORIES: 1960-1970
(in millions of dollars)

Budget Category	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Total Budget (I/RD) 1/	337	451	566	662	756	837	929	1034	1085	1095	1038
Total Extramural Program (I/RD)	283	391	499	574	656	729	806	909	947	946	881
Total Extramural Research	192	273	364	414	474	519	579	684	719	728	702
Regular Research Grants	163	220	266	305	351	370	402	444	456	455	437
Special Program Grants 2/	10	24	49	41	52	56	79	104	111	116	110
General Research Support Grants	--	--	18	26	30	39	39	45	54	53	50
Research Contracts	20	28	31	36	41	54	58	90	97	105	105
Training Grants	49	70	77	86	98	106	124	134	135	142	131
Fellowships (incl.Career Awards)	13	18	23	30	35	40	45	49	52	55	48
Research Facilities Construction	29	30	36	50	50	65	59	42	41	22	0
Total Academic Science (I/RD)	211	292	372	434	492	554	610	690	710	724	647
Research	137	189	255	292	338	372	413	483	510	529	486
Training and Fellowships	54	77	88	103	115	127	148	163	166	176	161
Facilities Construction	20	27	29	-39	39	55	49	35	35	19	0
Total Medical School Academic 3/ Science (NIH, incl. NIMH) 4/	145	209	280	302	357	397	439	482	478	508	483
Research	92	131	195	207	241	262	287	325	314	348	338
Training and Fellowships	40	58	65	79	94	103	121	138	142	154	145
Facilities Construction	14	21	21	16	22	32	31	18	22	6	0
Total Medical School Academic Science (I/RD)	NA 5/	NA	NA	NA	NA	NA	NA	436	429	452	425
Research	NA	NA	NA	NA	NA	NA	NA	308	295	327	315
Training and Fellowships	NA	NA	NA	NA	NA	NA	NA	110	112	119	110
Facilities Construction	NA	NA	NA	NA	NA	NA	NA	18	22	6	0

1/ Total budget excludes PL 480 Funding
2/ Specific Program Grants includes PL 480 Funding
3/ Includes schools of osteopathy for 1969-1970
4/ Includes I&RD's, BEMT, and NLM
5/ Figures not available

~~TABLE 2~~

ADPPE-NIH
5/71

NIH OBLIGATIONS FOR VARIOUS BUDGET CATEGORIES: 1960-1970 (Normalized to 1960 = 100)

Budget Category	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Total Budget (I/RD)	100	135	168	196	224	248	276	307	322	325	308
Total Extramural Program (I/RD)	100	140	176	203	232	258	285	321	335	335	311
Total Extramural Research	100	141	188	214	255	268	299	354	372	377	366
Training Grants	100	143	-157	175	201	216	253	274	275	290	267
Fellowships (inc.Career Awards)	100	138	215	230	269	309	346	377	400	423	369
Total Academic Science (I/RD)	100	138	176	205	233	262	289	322	337	343	307
Total Medical School Academic Science (NIH, Incl. NIMH)	100	144	193	208	246	274	302	333	330	350	333

7

NIH EXTRAMURAL PROGR... OBLIGATIONS: 1960-1970

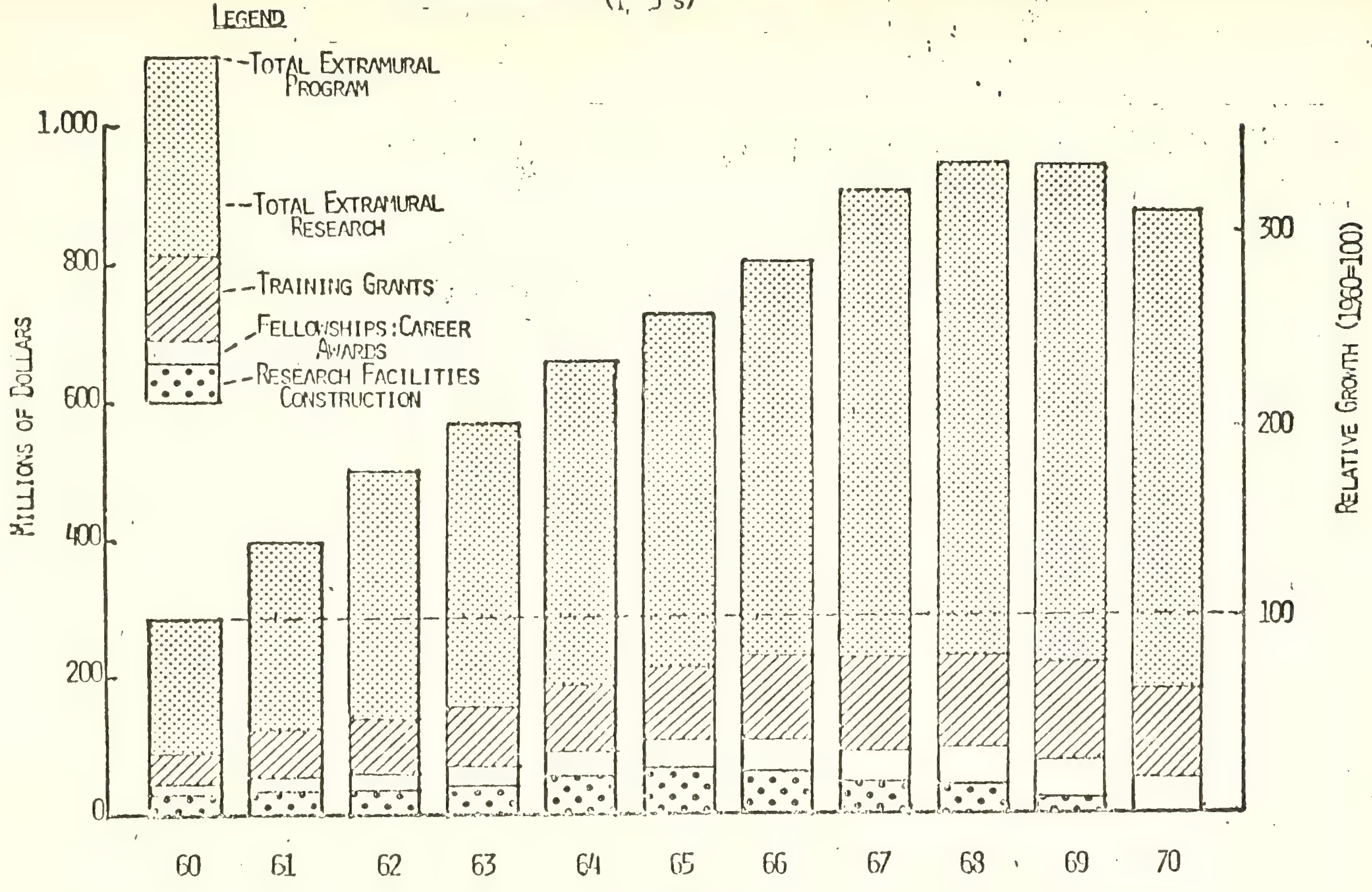


CHART 1

~~TABLE 4~~

NIH CONSTANT DOLLAR OBLIGATIONS FOR VARIOUS BUDGET CATEGORIES: 1960-1970
In Constant (1960) Dollars 1/
(in millions)

BUDGET CATEGORY	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Total Budget (I/RD)	337	451	553	638	718	779	843	909	917	883	794
Total Extramural Program (I/RD)	283	391	488	553	623	679	731	799	800	763	674
Total Extramural Research	192	269	355	399	450	483	525	601	607	587	537
Regular Research Grants	163	217	260	294	333	344	364	391	385	367	334
Special Program Grants	10	25	47	40	50	52	72	91	94	93	84
Gen'l. Research Support Grants	--	--	17	25	29	36	36	40	46	43	38
Research Contracts	20	27	30	34	39	50	53	79	82	84	80
Training Grants	49	70	75	83	93	99	112	118	114	114	100
Fellowships (incl. Career Awards)	13	17	23	29	33	37	41	43	44	44	37
Research Facilities Construction	29	35	35	48	47	60	53	37	35	17	0
Total Academic Science (I/RD)	211	289	363	418	468	515	553	597	600	584	495
Research	137	186	249	281	321	347	375	424	430	426	372
Training and Fellowships	54	76	86	99	109	118	134	143	141	142	123
Facilities Construction	20	26	28	38	37	51	44	31	29	15	0
Total Medical School Academic Science (NIH, incl. NIMH)	145	207	274	291	339	370	398	423	404	410	370
Research	92	129	190	200	299	244	260	286	266	281	259
Training and Fellowships	40	27	63	76	90	96	110	122	120	124	111
Facilities Construction	14	21	20	15	21	30	28	16	18	5	0
Total Medical School Academic Science (I/RD)	NA 2/	NA	NA	NA	NA	NA	NA	383	362	364	325
Research	NA	NA	NA	NA	NA	NA	NA	271	250	264	241
Training and Fellowships	NA	NA	NA	NA	NA	NA	NA	97	95	96	84
Facilities Construction	NA	NA	NA	NA	NA	NA	NA	16	18	5	0

1/ Based on implicit GNP deflator--See Table 3
2/ Figures not available

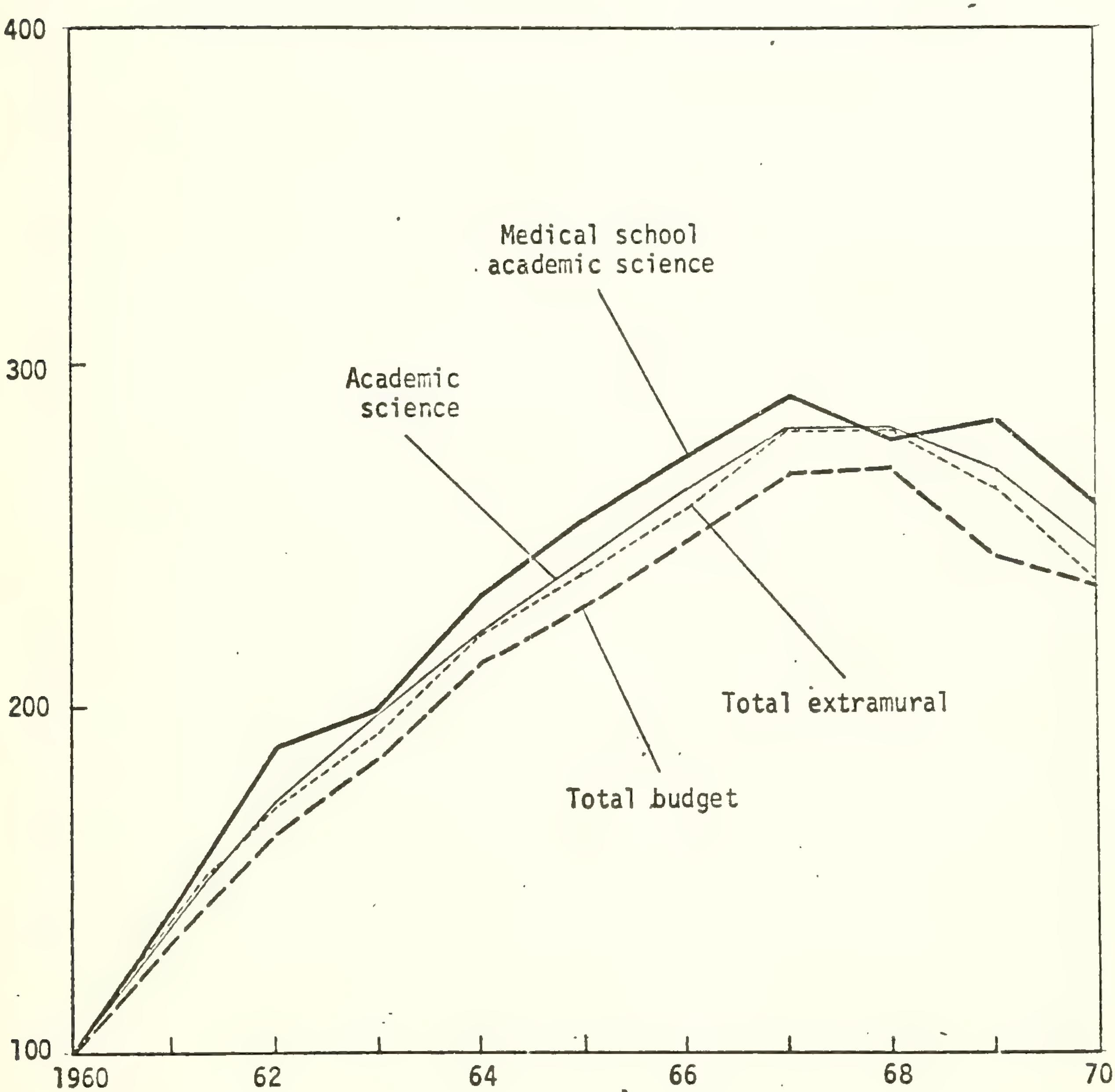
TABLE 4a

NIH OBLIGATIONS FOR VARIOUS BUDGET CATEGORIES IN CONSTANT 1960 DOLLARS
1960-1970 (Normalized to 1960 = 100)1/

BUDGET CATEGORY	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Total Budget (I/RD)	100	134	164	189	213	231	250	270	272	262	236
Total Extramural Program (I/RD)	100	138	172	195	220	240	258	282	283	270	238
Total Extramural Research	100	140	185	208	234	252	273	313	316	306	280
Training Grants	100	143	153	169	190	202	229	241	233	233	204
Fellowships (incl. Career Awards)	100	131	177	223	254	285	315	331	338	338	285
Total Academic Science (I/RD)	100	137	172	198	222	244	262	283	284	277	235
Total Medical School Academic Science (NIH, Incl. NIMH)	100	143	189	201	234	255	274	292	279	283	255

1/ Based on implicit GNP deflator--See Table 3

NIH OBLIGATIONS FOR SELECTED BUDGET CATEGORIES, 1960-1970
(Constant 1960 Dollars, Normalized to 1960 = 100)



ORA-OADPPE-NIH
January 1971

GROWTH OF MEDICAL SCHOOL FACULTY SALARIES 1960-1970
(AVERAGE OF 8 CLINICAL DEPARTMENTS)

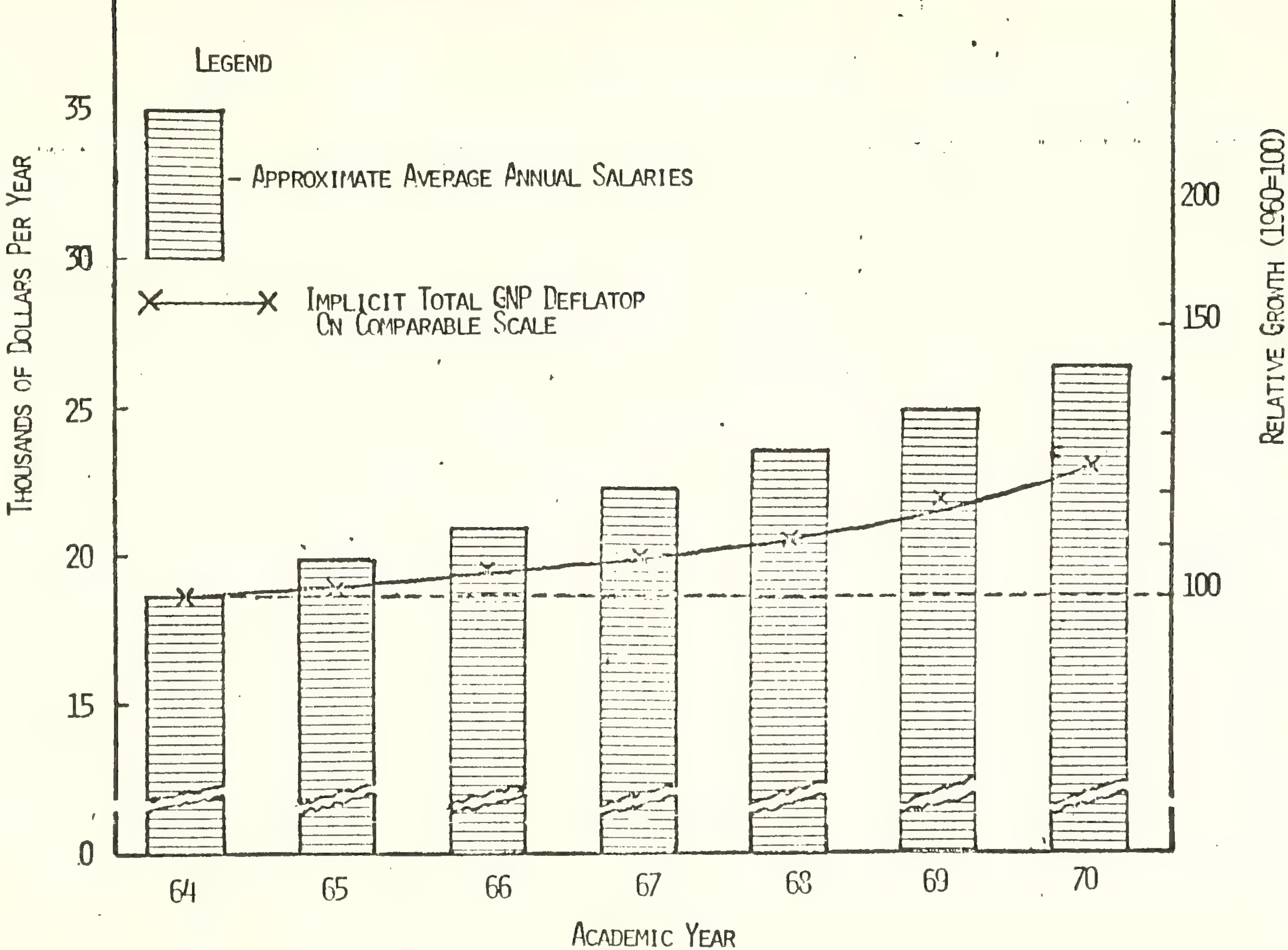


CHART 3

GROWTH OF INCOMES OF PRACTICING PHYSICIANS 1964-1970

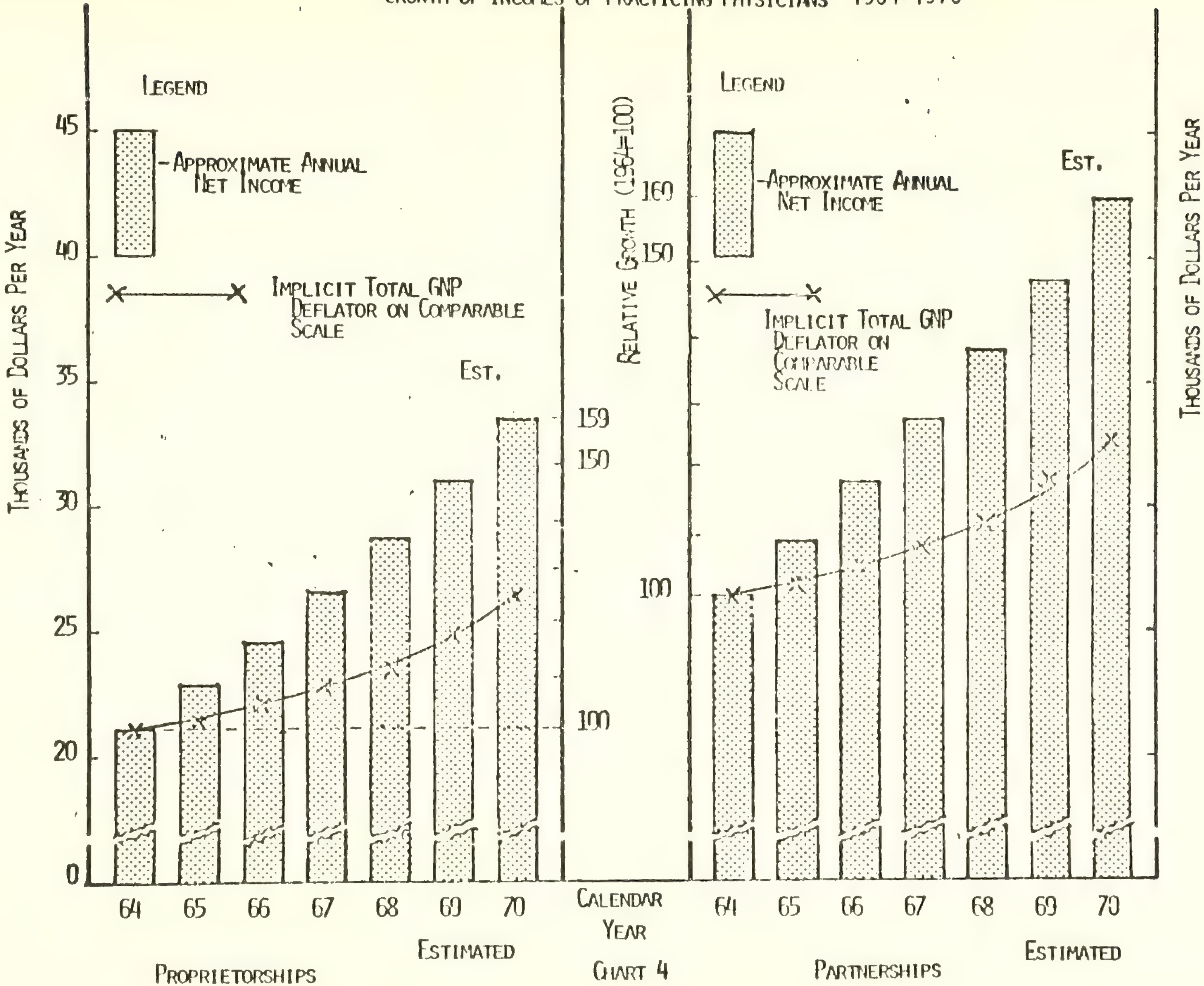


CHART 4

Comparison of Incomes of Physicians in Practice and Medical School Faculty Salaries 1964-1970

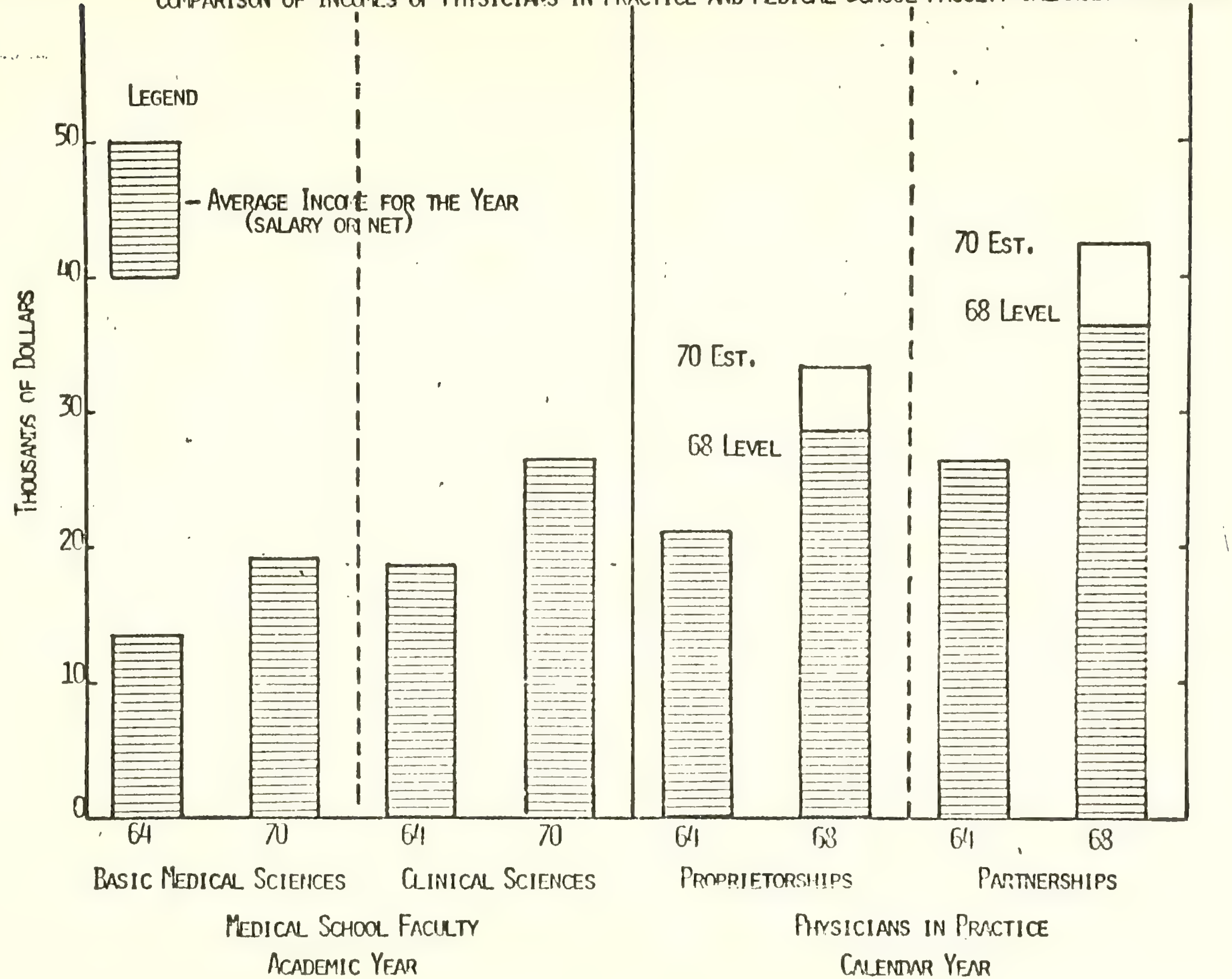


Chart 5

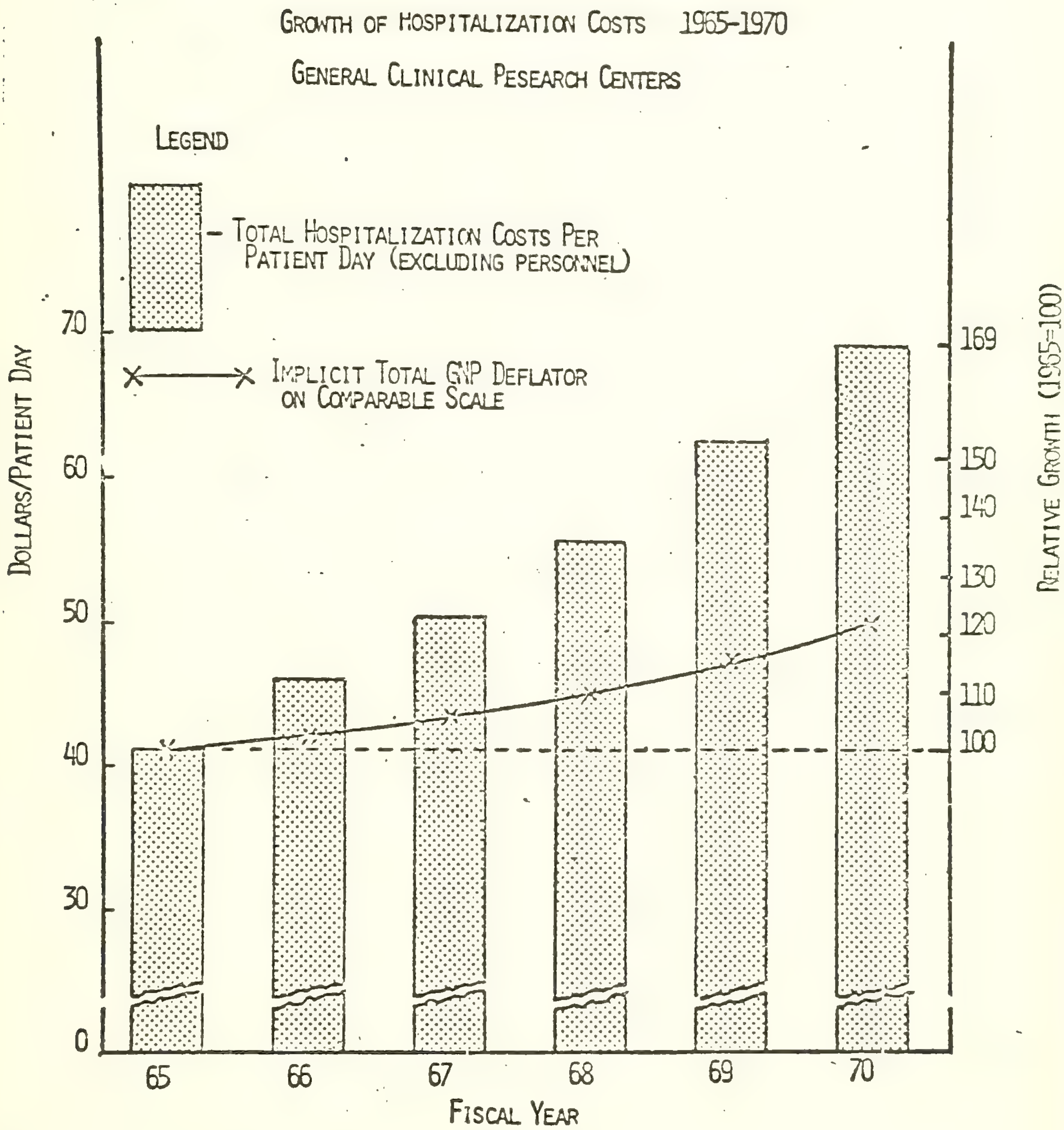
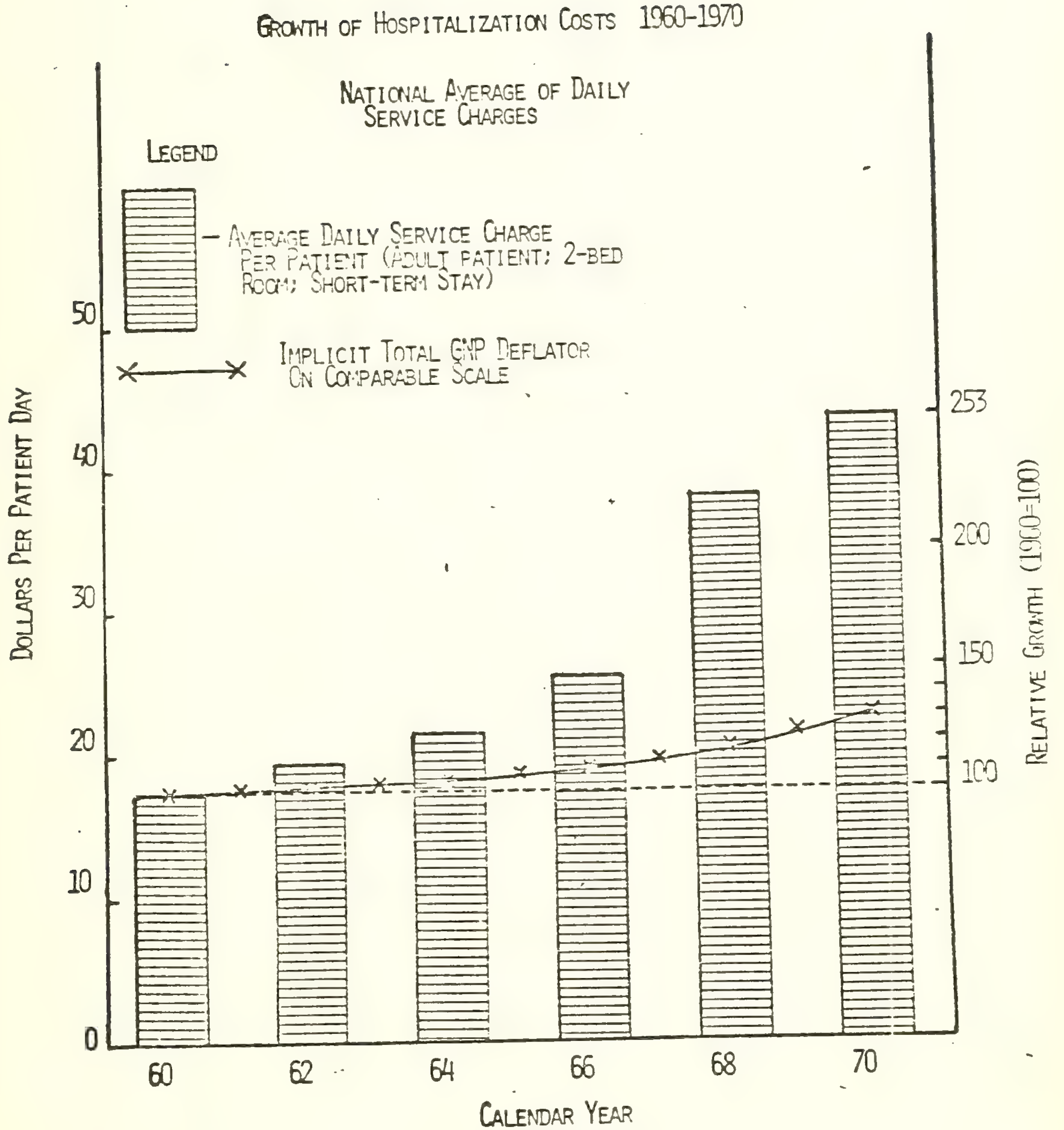

Growth of Hospitalization Costs 1965-1970
General Clinical Research Centers
Legend
– Total Hospitalization Costs Per Patient Day (Excluding Personnel)
Implicit Total GNP Deflator on Comparable Scale
Dollars/Patient Day
0
30
40
50
60
70
Relative Growth (1965=100)
100
110
120
130
140
150
169
65
66
67
68
69
70
Fiscal Year

Chart 7

1.c



GROWTH OF HOSPITALIZATION COSTS 1960-1970
NATIONAL AVERAGE OF DAILY SERVICE CHARGES
LEGEND
AVERAGE DAILY SERVICE CHARGE PER PATIENT (ADULT PATIENT; 2-BED ROOM; SHORT-TERM STAY)
IMPLICIT TOTAL GNP DEFLATOR ON COMPARABLE SCALE
DOLLARS PER PATIENT DAY
RELATIVE GROWTH (1960=100)
0
10
20
30
40
50
100
150
200
253
60
62
64
66
68
70
CALENDAR YEAR

CHART 8

SUMMARY OF APPROPRIATIONS, 1970-[illegible], AND PRESIDENT'S BUDGET, 1972

National Institutes of Health

(Amount in millions)

Component	1970 Actual	1971 President's Budget	1971 Cong. Appropriation (comparable)	1972 President's Budget	Increase 1970/72
Subtotal, IRD's	$1,012.5	$1,100.5	$1,178.3	$1,283.3	$270.8
Cancer	179.0	202.4	229.6	232.2	53.2
Heart	156.7	171.7	191.2	194.4	37.7
General medical sciences	142.9	148.4	160.7	150.1	7.2
Arthritis	128.4	132.2	135.8	134.4	6.0
Neurology	92.7	97.0	102.6	95.5	2.8
Allergy	94.1	99.2	98.8	98.4	4.3
Child Health	75.4	93.3	94.0	102.5	27.1
Dental	28.3	34.6	34.9	38.4	10.1
Eye	24.2	25.7	31.5	32.4	8.2
Environmental health	17.2	19.9	20.6	25.0	7.8
Biologic standards	7.8	8.6	8.6	8.6	0.8
Fogarty center	3.2	2.7	3.7	3.3	0.1
Research resources	62.7	65.0	66.4	67.9	5.2
Cancer research initiative			----	100.0	100.0
Total, NIH	$1,443.9	$1,509.6	$1,694.6	$1,889.5	$445.6

ALLERGY & INFECTIOUS DISEASES

- Bacterial diseases
- Fungal
- Parasitic
- Viral, mycoplasmal & rickettsial
- Allergic & immune disorders
- Other problems—microbial drug resistance, antimicrobial substances, etc.

ARTHRITIS & METABOLIC DISEASES

- Arthritis & other diseases of bones, joints & muscles
- Metabolic & endocrine disorders, genetic and nongenetic
- Gastrointestinal diseases & nutrition
- Renal disease, artificial kidney
- Anemias & other blood diseases
- Dermatology

CANCER

- Causation & prevention
- Nature & development
- Diagnosis & treatment

CHILD HEALTH & HUMAN DEVELOPMENT

- Population & family planning
- Infant mortality
- Nutrition
- Development & aging
- The handicapped child

DENTAL

- Dental caries & hard-tissue studies
- Periodontal disease
- Congenital & acquired anomalies
- Oral neoplasia
- Biomaterials
- Salivary glands
- Oral & dental infections & conditions

ENVIRONMENTAL HEALTH SCIENCES

- Identification & epidemiology of environmental hazards
- Chemical, biological & physical factors injurious to man
- Effects of environmental contaminants on man

EYE

- Disorders of the retina & visual pathways
- Corneal disease
- Glaucoma
- Cataract
- Congenital & inherited defects
- Anomalies of refraction
- Strabismus & amblyopia

GENERAL MEDICAL SCIENCES

- Basic biomedical sciences: anatomy, physiology, pathology, etc.
- Anesthesiology
- Pharmacology-toxicology
- Medicinal chemistry
- Genetics & genetic chemistry
- Biomedical engineering
- Structure & function of living materi

HEART & LUNG

- Atherosclerosis
- Hypertension
- Congenital heart disease
- Rheumatic heart disease
- Cardiopulmonary disease
- Heart failure & shock
- Coronary artery disease
- Thromboembolic & hemorrhagic disease
- Artificial heart - myocardial infarct
- National blood resource program

NEUROLOGICAL DISEASES & STROKE

- Chronic neurological disorders of childhood & of aging
- Cerebrovascular disease
- Epilepsy & paroxysmal
- Sclerosing disorders
- Muscular & neuromuscular
- Infectious neurology
- Accident & injury
- Tumors of the nervous system
- Disorders of speech, hearing

BIOLOGICS STANDARDS

- Virology & rickettsiology
- Viral immunology
- Animal tests & histopathology
- Blood & blood products
- Bacterial products
- Biophysics & biochemistry
- Control activities

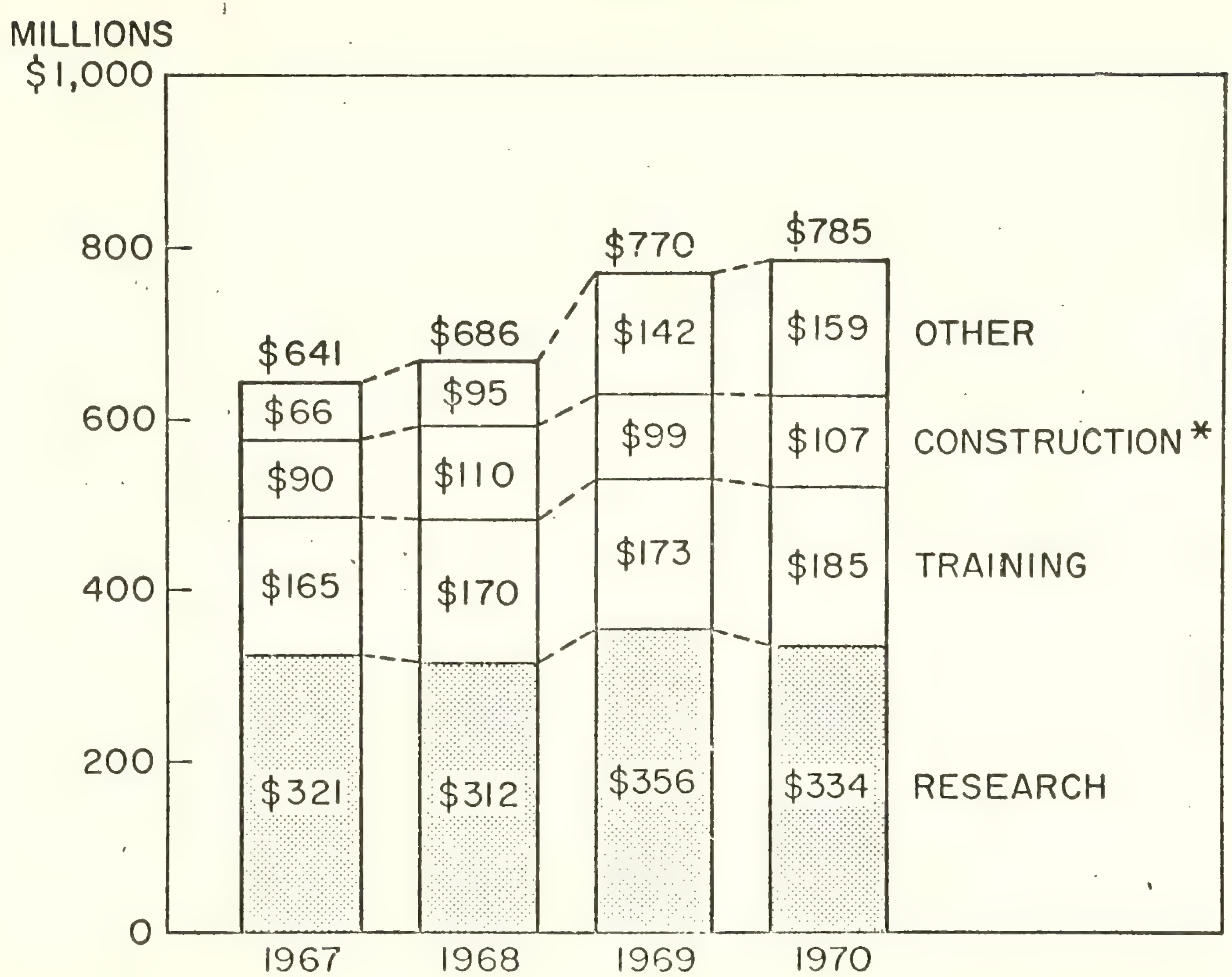
SUMMARY OF APPROPRIATIONS, BY ACTIVITY, 1970-1972
National Institutes of Health

(Amount in millions

Activity	1970 Actual	1971 President's Budget	1971 Cong. Appropriation (comparable)	1972 President's Budget	Increase 1970/72
Subtotal, IRD's	$1,012.5	$1,100.5	$1,178.3	$1,283.3	$270.8
Research grants	592.7	611.3	672.5	680.5	87.8
Regular program	442.1	449.3	484.7	497.2	55.1
Special programs	150.6	162.0	187.8	183.3	32.7
General research support	50.3	39.8	52.7	41.2	-9.1
Multidisciplinary centers	25.5	37.3	54.2	60.6	35.1
Other special programs	74.8	84.9	80.9	81.5	6.7
Fellowships	47.8	44.8	49.9	42.9	-4.9
Training grants	108.2	132.0	116.8	109.8	1.6
Direct operations	263.9	312.6	339.1	350.1	86.2
Laboratory and clinical research	90.3	102.5	103.7	109.0	18.7
Collaborative R&D	127.1	165.6	185.5	190.0	62.9
Other	46.5	44.5	49.9	51.1	4.6
Cancer research initiative				100.0	100.0
Total, NIH	$1,443.9	$1,509.6	$1,694.6	$1,889.5	$445.6

(13)

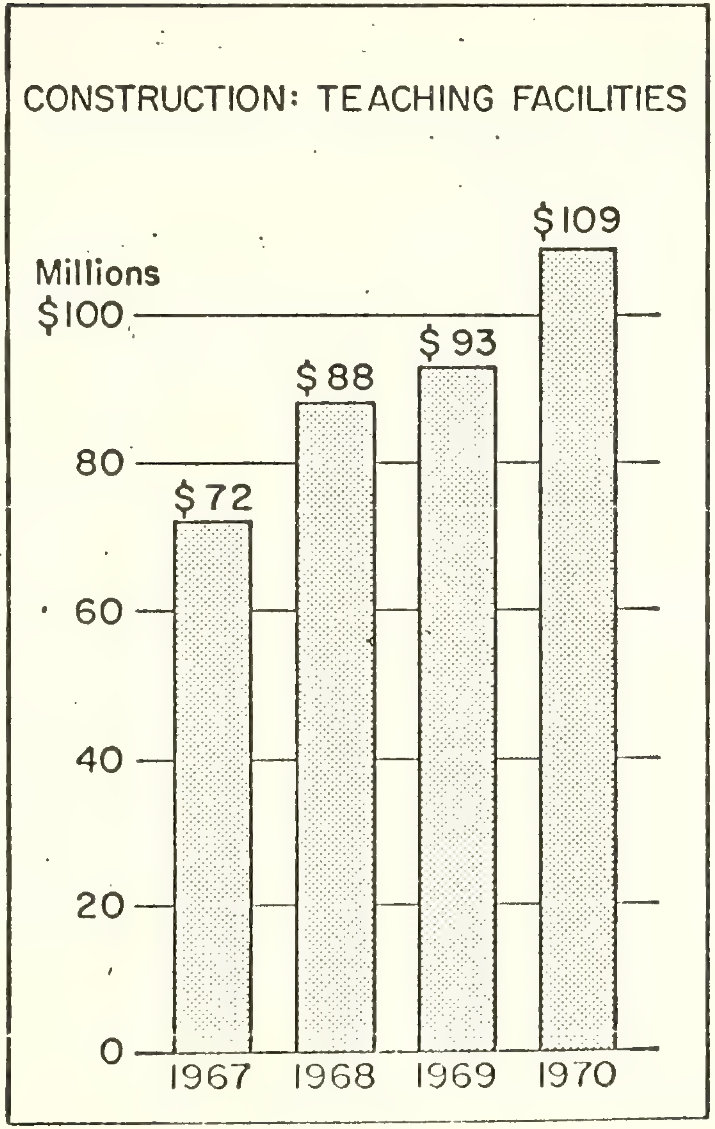
DHEW OBLIGATIONS TO MEDICAL SCHOOLS
1967-1970

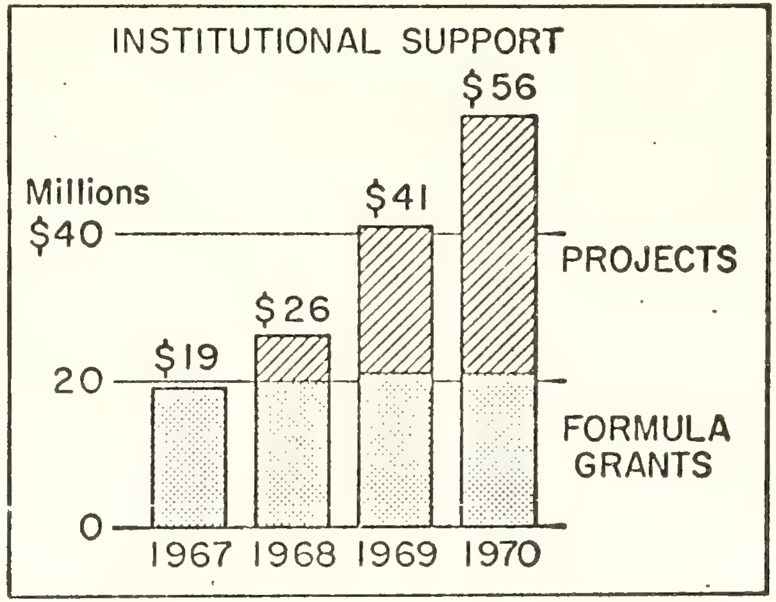


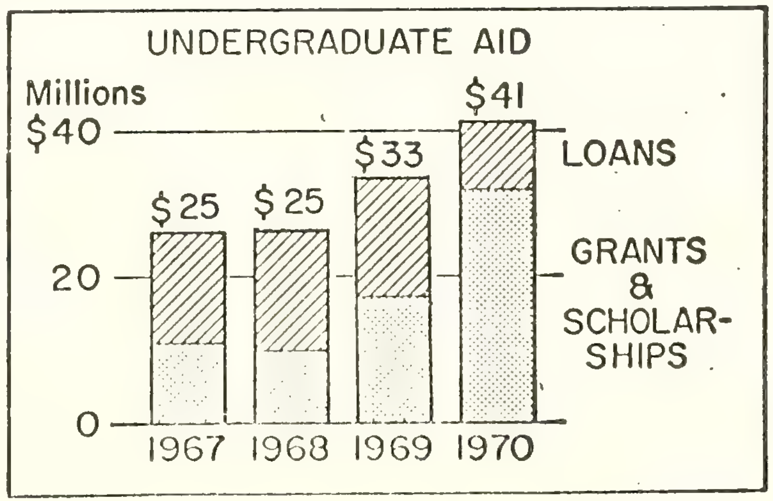
* Includes R & D plant

ORA-ADPPE-NIH
May 1971

EXPANDING HEA H RESOURCES
Selected DHEW Programs at Medical Schools
1967-1970







ORA-ADPPE-NIH
May 1971

CHANGES AND TENDENCIES

ACADEMIC SCIENCE SUPPORT PROGRAMS OF NIH

- ORGANIZATIONAL CHANGES: SINCE 1968 A NEW MANDATE FOR HEALTH PROFESSIONAL EDUCATION
- A SHIFTING EMPHASIS TO HEALTH SERVICES
- STRENGTHENING ACADEMIC SCIENCE: IMPLICATIONS OF THE PRESIDENT'S BUDGET FOR FY 1972
- TARGETED PROGRAMS: CANCER, HEART, DENTAL HEALTH, CHILD HEALTH, FAMILY PLANNING, POPULATION STUDIES
- A NEW VIEW OF TRAINING
- OTHER PROGRAM CHANGES --

  -- DECLINE OF GENERAL RESEARCH SUPPORT
  -- RISE AND FALL OF HEALTH SCIENCES ADVANCEMENT AWARDS
  -- INCREASING IMPORTANCE OF CONTRACT RESEARCH
  -- EMPHASIZING CORE FACULTY SUPPORT

ORGANIZATION OF HEALTH ACTIVITIES WITHIN DHEW

ASSISTANT SECRETARY for HEALTH and SCIENTIFIC AFFAIRS

SURGEON GENERAL
PUBLIC HEALTH SERVICE

PUBLIC HEALTH SERVICE

NATIONAL INSTITUTES of HEALTH

- OFFICE OF THE DIRECTOR
- INSTITUTES
  (NCI, NHI, NIAMD, NIAID, NIND, NIDR, NIGMS, NICHD, NIEHS, NEI)
- DIVISIONS
  (DRG, DRS, CC, DRFR, DCRT)
- BUREAU OF HEALTH PROFESSIONS EDUCATION AND MANPOWER TRAINING
- NATIONAL LIBRARY OF MEDICINE
- FOGARTY INTERNATIONAL CENTER

HEALTH SERVICES & MENTAL HEALTH ADMINISTRATION

- OFFICE OF THE ADMINISTRATOR
- BUREAU OF HEALTH SERVICES
- NATIONAL CENTER FOR HEALTH STATISTICS
- NATIONAL INSTITUTE OF MENTAL HEALTH
- REGIONAL MEDICAL PROGRAMS
- NATIONAL COMMUNICABLE DISEASE CENTER
- NATIONAL CENTER FOR HEALTH SERVICES R&D

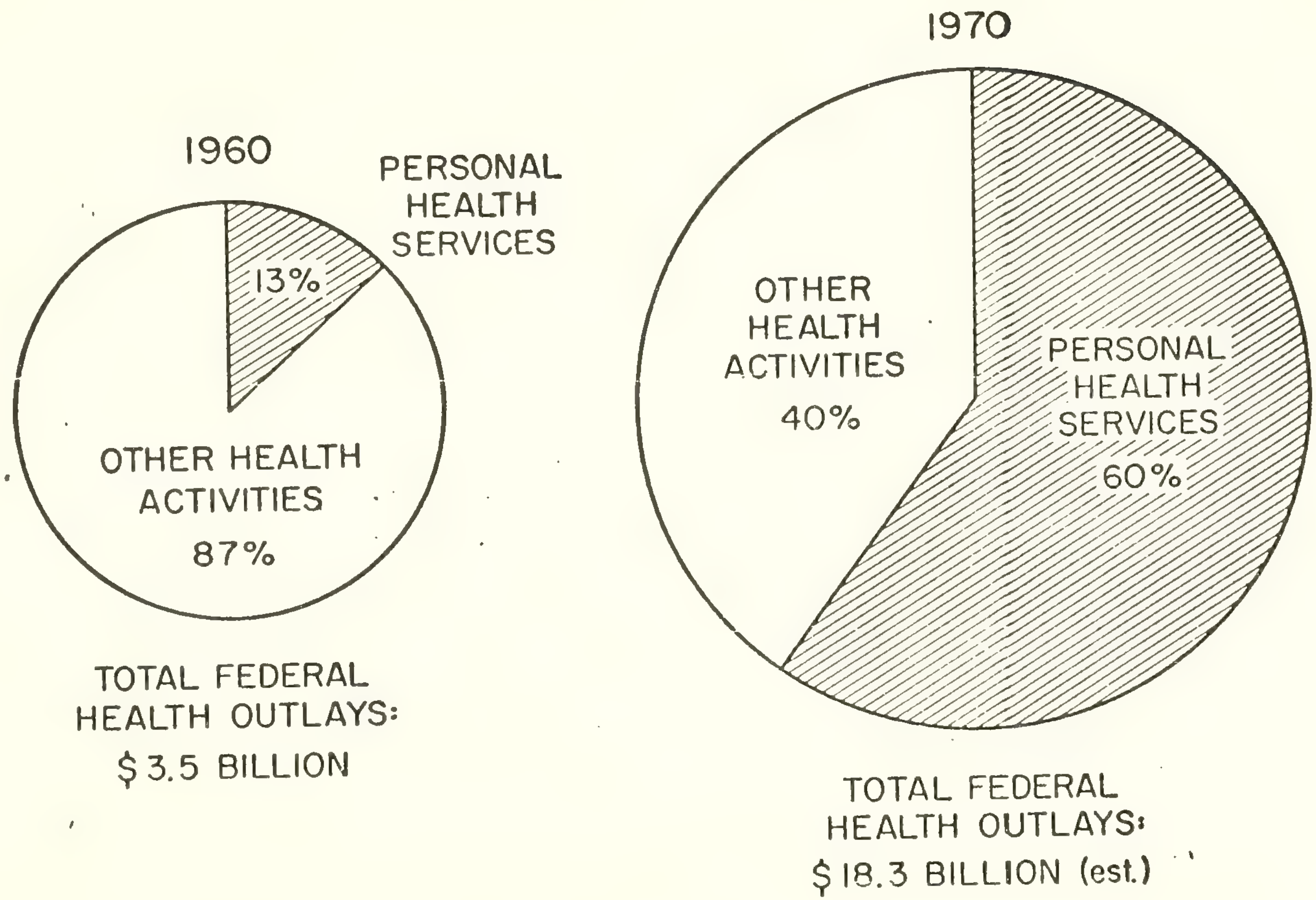
CONSUMER PROTECTION & ENVIRONMENTAL HEALTH SERVICE

- OFFICE OF THE ADMINISTRATOR
- ENVIRONMENTAL CONTROL ADMINISTRATION
- FOOD AND DRUG ADMINISTRATION
- NATIONAL AIR POLLUTION CONTROL ADMINISTRATION

OCTOBER 1968

FEDERAL FUNDS FOR PERSONAL HEALTH SERVICES AS A PROPORTION OF TOTAL FEDERAL HEALTH OUTLAYS

1960 AND 1970



SOURCE: Budget of the United States, FY 1970
Special Analysis L.

ORA-ADPPE-NIH
May 1971

PROJECT CONTRACTS: TARGETED PROGRAMS
National Institutes of Health
1970 - 1972

(thousands)

Institute	1970 actual	1971 President's Budget	1972 President's Budget	Increase, 1970-72 (percent)
Total I/RD's	$96,023	$145,565	$204,485	112.9
Cancer	44,936	71,345	125,535 1/	179.4
Heart	19,754	26,957	28,703	45.3
Dental	554	3,079	4,479	708.5
Child health	7,023	15,977	18,869	168.7
Other I/RD's	23,756	28,207	26,899	13.2

1/ Includes Cancer Research Initiative

PROBLEMS AND ISSUES:
ACADEMIC SCIENCE SUPPORT PROGRAMS OF NIH

- UNCERTAINTY OF CURRENT SITUATION
- PROBLEMS IN LONG-RANGE PLANNING
- PLURALISM vs. CENTRALIZATION: A PERENNIAL ISSUE
- ESTABLISHING A NATIONAL INSTITUTE OF RESEARCH AND ADVANCED STUDIES (NIRAS)
- TOWARD A FEDERAL POLICY FOR HIGHER EDUCATION
  - -- INSTITUTIONAL SUPPORT VS. STUDENT AID
  - -- SUPPORT FOR SCIENCE VS. ARTS AND HUMANITIES
  - -- LOANS VS. GRANTS
- THE NEW FEDERALISM: POTENTIAL IMPACT ON EDUCATIONAL FINANCING
  - -- REVENUE-SHARING
  - -- WELFARE REFORM

TAB 5

ADPPE Revised
5-19-71

DR. KENNEDY'S SPEECH
IN DEDICATION OF THE PRIMATE BUILDING
MAY 20, 1971

It is a pleasure to welcome all of you to this dedication of our new Quarantine Primate Building at the NIH Animal Center. The activities to be carried out there will play an important role in the support of our research programs. On this occasion it seems particularly appropriate to consider some of the ways in which primates and other animals play a vital role in biomedical science.

More than 50 million animals are used annually in research in the United States. The National Institutes of Health alone uses about one million laboratory animals per year at its Bethesda laboratories and three million in its Cancer Chemotherapy Program. In addition, approximately 57 percent of the 12,000 research grants currently supported by NIH are dependent on the use of animals. There is no doubt that studies involving animals have been indispensable to the virtual eradication of polio, undulant fever, the nutritional deficiency diseases, and other scourges of yesterday, and to the great strides that have been made against diabetes, tuberculosis, and the insect-borne febrile infections. Complex surgical procedures such as the corrective operations for congenital heart disease, artery and organ transplantations, and refinements in orthopedic surgery were also based on animal experiments.

As a result of these and other successes, as well as the advance in knowledge of animal and human physiology, scientists have increased their reliance upon animals in research. Laboratory animals are not

only used in greater numbers, but their quality and definition has become greatly refined. As capabilities increased and instruments became more precise and sophisticated, there was need for more uniform and specially bred stocks.

The field of comparative medicine is by no means new. In American research institutions, laboratory animals have been used since the 1850's. The field developed at a rather slow pace, and funds for the support of animal facilities and activities usually received a low priority. Little attention was given in the early days to the animals' environmental or nutritional requirements, nor to their naturally occurring diseases. Laboratory animal medicine was far from sophisticated, and a great deal of development was needed before it could support research as we know it today.

In the 1920's, more attention was given to the study of laboratory animal diseases and colony management, and a few excellent animal colonies were developed. Still, the field really did not begin to move toward its present-day capability until after the Second World War. Today, I believe that everyone in the field of biomedical research recognizes the importance of high-quality, well-defined animals of known characteristics to support their studies. It is also recognized that such animals are only to be had through the efforts of well-trained professionals working with the proper equipment in adequate facilities. Through the extramural and intramural activities of NIH, programs have been initiated to meet some of these needs.

Extramurally, NIH established and continues to support the Regional Primate Research Center Program. From this evolved support of other

types of animal resources in biomedical research institutions. Postdoctoral training programs are conducted for the preparation of specialists in laboratory animal medicine and care. Grants have been made for the development of specific animal models, the study of laboratory animal diseases, and the acquisition of more basic data on environmental factors affecting these animals.

With NIH support and encouragement, the Institute of Laboratory Animal Resources of the NAS/NRC prepared the Guide for Laboratory Animal Facilities and Care. More than 75,000 copies of the Guide have been distributed since the first edition was published in 1963. Its reception in the scientific community has been very favorable. As stated in the preface to the third edition: "The primary purpose of the Guide continues to be to assist scientific institutions in providing professionally appropriate care for laboratory animals. The recommendations are based on scientific principles and on expert opinion and experience with methods and practices that have proved to be consistent with high quality care."

The NIH intramural programs have also provided leadership in the field of laboratory animal development. Early in these efforts, information was gained about the control and elimination of diseases that could affect various laboratory animals. Many genetic strains with unique heritable characteristics were developed, and techniques for the large-scale production of germfree and pathogen-free animals were employed. Methods of animal experimentation were improved. Viable programs have continually evolved to meet the needs of our Institutes and research Divisions.

As the major Federal biomedical research organization, NIH must also play a special role in the support of certain national requirements.

For example, NIH workers have developed special genetic strains and have maintained these and other strains developed elsewhere. Currently we have more than 65 strains of rodents exhibiting a wide variety of susceptibilities, pathologic conditions, or unique physiologic traits useful in biomedical research. NIH serves as an international source of these animals for the establishment of new breeding colonies and as a recognized source of reference stocks.

What we have here is unique; it must be preserved and kept available as a national resource. Ways to meet this responsibility even better than in the past are being explored. For example, it was recently observed that some of the guinea pigs in our colonies are deficient in C-4 complement, a characteristic that makes them exceedingly valuable in certain types of immunology research. A small breeding colony of these animals has been established, primarily to meet our own needs, but we hope eventually to make breeding stock available to the entire biomedical research community.

Along this line, there is need for the further recognition and development of animal models for biomedical research. It has become apparent that most human disease problems have counterparts in the animal world--counterparts that must be sought where they have not yet been recognized. Toward this end, we need a closer union of physicians, veterinarians, and other biologists. Once such models have been developed, they must be adapted to the laboratory and disseminated to those who need them for their research. The recent successes in studying kuru in chimpanzees and squirrel monkeys, and the viral production of lymphocytic leukemia and malignant lymphoma in owl monkeys, demonstrate the potential for new models to study slow viruses and cancer viruses.

NIH workers have also organized programs to conserve laboratory animals. A canine blood donor colony was established to eliminate the need to sacrifice dogs in order to prime heart-lung machines in experimental surgery. This greatly reduces the number of dogs used each year. We also save animals by developing better methods for their nutrition, care, and disease control. The recently inaugurated Animal Disease Investigation Service makes available to our 1,200 intramural investigators the clinical and diagnostic services of veterinarians and other professionals in the control and elimination of animal disease problems.

Nonhuman primates have played an important role in NIH's research programs. Currently, our intramural investigators are using more than 9,000 of these animals. Approximately 2,500 are housed here in Bethesda and the remainder in contractors' facilities. Primates have been the key to testing of polio vaccines and have been important in studies of infectious diseases, neurological conditions, perinatal physiology, and behaviour. Their importance in cancer research and surgical studies is growing.

Primates, of course, require special consideration because of the difficulties in their maintenance and the fact that many of them are imported from the wild and carry diseases that can be hazardous for man and for other animals. It is standard procedure here at NIH for all of the primates to be brought into a central facility for quarantine and conditioning before they are sent to various research laboratories. This program will continue in the new building we are dedicating today. The transfer of this operation to Poolesville will afford an opportunity to provide a central primate holding facility here in Bethesda. Previously

the NIH investigator who wanted to try something new in primates either had to develop the space in his own Institute or use a contractor's facility. There was no provision for the use of small numbers of animals to conduct pilot studies. This will now be possible.

We are also looking ahead to new needs in the primate field. It is becoming increasingly evident that NIH must provide for the breeding of primates. Many investigations require the availability of animals with timed pregnancies, and other studies require neonates of known age and medical history. Most importantly, primates may not always be readily available from the wild; there are indications that their supply may be decreased by population pressures in some of the source areas. We foresee the day when the primate building will be used more and more for breeding and perhaps less and less for quarantine. These observations, of course, are not new to most of you in this audience; but I want to bring out the fact that many people at NIH are cognizant of these problems and are giving them attention.

For the dedication of this building, we felt that it would be appropriate to bring together members of the scientific community with a particular interest in primates. Further, we wanted to have a symposium that would provide a common ground for such a group. Although the subject is an old one, tuberculosis in primates still poses many challenging questions, and there is an opportunity to dispel much misinformation and misunderstanding.

Certainly, almost everyone who works with primates has a common interest in this problem. Recently, in our own facilities, we experienced an outbreak of tuberculosis in a laboratory that housed 75 primates on

a long-term study. Many of these animals had been born and bred in captivity, but somehow tuberculosis had entered the colony. The disease spread rapidly, and approximately one-quarter of the colony had to be eliminated. The investigator calculated that several of these animals had up to $50,000 worth of research time and effort invested in them. These are some of our reasons for choosing the topic "Dealing with Tuberculosis in Primate Colonies."

We feel confident that information disseminated here will be useful to the entire biomedical research community, providing a clearer understanding of this disease and its control. It will also help in the recognition of areas that need further investigation. With these objectives in mind, let us proceed with this symposium, which will serve as the dedication of our new Primate Building.

TAB 6

COMMENTS ON THE PAPER OF DR. IVAN L. BENNETT
ENTITLED "SUPPORT OF RESEARCH AND GRADUATE EDUCATION IN THE UNITED STATES"

Delivered in the Seminars on Science and Public Policy
at Rockefeller University
December 9, 1971

Thomas J. Kennedy, Jr, M.D.

It's always a difficult task to add anything to one of Dr. Bennett's typically masterful presentations or to contribute new insights to those already laid before you by the distinguished prior speakers in this series of seminars. In reading the manuscripts and ruminating about them, however, it seemed to me that events of the last few years, particularly the leveling of Federal expenditures for R&D, have had one big positive dividend: the call for analysis, reflection and assessment that is both timely and promising. At the moment, thinking on the subject seems to be in the "mugwump" stage, in part dominated by traditional values and simultaneously reflecting the enormous transformation wrought during the last three decades in the role of science in society.

Looked at in perspective, the several quantum leaps in the magnitude of the science enterprise since about 1940 may be viewed as a sharp discontinuity with a long tradition of basic stability coupled to slow growth. In many ways, the world of science has only incompletely explored and perhaps only partially experienced the consequences of its new estate. A forum such as Dr. Shannon has organized will surely lead to a better digestion and integration of the changes and illuminate the direction for a new synthesis for the governance of science in the nation.

A couple of the dimensions of the transformation that seem particularly important to me relate to *size* and to *Federal support:*

- Size, as measured by any number of surrogates--funds expended, numbers of people engaged, scope of concern, expansion in plant--has created many unprecedented conditions. Among other things, the income requirements of performing institutions have increased to levels unimaginable even a generation ago and converted academic officials such as deans into a breed that must bear all of the heavy burdens--without any of the generous rewards--of Wall Street financers.

- Federal dependency has awakened performers and performing institutions to a new and painful appreciation of the Federal budgetary process with all of its formal discipline as well as with the host of undisciplinable forces and pressures from countless publics and constituancies which impinge upon and influence it. The Federal Budget each year announces to the Congress the political platform of the President of the United States; when the opposite party controls the Congress, the

President's budget message is a guantlet. In it the President reflects his own best judgment of how to carry out his election mandate, how best to balance all of the contending and conflicting aspirations of a diverse and pleuralistic society. The President's assessments are annually subject to micro variations in emphasis, determined by gentle winds of shifting public taste. But they must also reflect macro changes, precipitated by major and often unexpected reordering of national priorities. The Federal budgetary process may appear to the scientific and academic communities to be a bronco. Wishes of these groups to the contrary notwithstanding, I suspect the bronco will not be broken but will have to be ridden. There is evidence that skills for the latter task are resident in abundance within the scientific community.

The issues yet to be resolved are whether or not some of the invaluable traditions of yesteryears enterprise--far smaller and far more dependant on non-public funding--whether or not the traditions of a more courtly and genteel era can survive.

The set of problems surrounding graduate training in the sciences illustrate many knotty aspects of the issue. Like Dr. Bennett, I too have been deeply immersed in this subject for the last couple of years and concur in his assessment that it presents many complex, challenging and researchable questions. Let me mention a few. Scientific research has been professionalized and--to introduce a term that thirty years ago would have been considered a barbarism--a research manpower labor market is casually discussed. Students undertake graduate education to qualify themselves for lifetime careers in research. Supply/demand considerations have emerged and conventional wisdom currently seems to accept the premise that labor market demand be measured and labor supply be regulated to minimize the difference between supply and demand. Students expect not to be led down primrose career paths, Federal Agencies expect that students trained at Agency expense use the training, and the Congress and general public look ascance at the spectacle of the talent of highly specialized manpower underutilized, especially when trained at public expense.

In this context, how can universities retain autonomy, freedom, independence? How can they control their own graduate programs and graduate enrollments when there is a generally recognized need to concertize--in the service of balancing supply and demand--for example, the activities of more than 150 universities which grant Ph.D.'s in the basic biomedical sciences? Can the universities confederate and cooperate on a problem like this? Can some be expected to volunteer to amputate an integral part of their programs? What processes in the event of no volunteers? These aspects of the governance problem were recently raised by Wolfle & Kidd, as Dr. Bennett noted.

Another issue related to graduate training is the phenomenom of ossillation. A tendency for this to occur might be expected from consideration of the lengthy period required for scientific training; unless a shortage or surplus of supply is foreseen well in advance and appropriate adjustments made early in the number of people entering the training pipeline, overshoot will occur since the preexisting output level will be maintained for many years before the adjusted intake is reflected. Moreover, students entering (or not entering) the pipeline in response to a signal of over--or under-production tend to behave congruently but without reliable perspective on how others are behaving. Thus, the response to such a signal tends toward "all or none," resulting in an amplified, rather than the desired damped, response.

Illustrative is the recent experience of the nation in the employment opportunities for elementary and secondary school teachers. The birth rate rose sharply from 19.5 per thousand in 1945 to 26.5 per thousand in 1947 and remained at about this latter level until 1958; this harbinger of a need to accommodate about one million extra children per year in each successive grade did not stimulate expansion of teacher production significantly until about 1952 or 1953 when the first cohort entered the school system and created a memorable perturbation involving elimination of kindergartens, overcrowding of classrooms, double sessions, tremendous overloads on teaching staff and so forth.

In the heat of the fray, a peaking of birth rates in 1958 and unmistakable evidence of a downward trend by 1961 went almost unnoticed. In the prevailing crisis, few had the foresight to recognize the desirability of discontinuation of a policy of encouraging teaching careers and those sufficiently perceptive to recognize the new trend and courageous enough to articulate the message were able to attract little attention. Accordingly, action was again late and the country now has an undeniable surplus of elementary and secondary school teachers. Thus, the nation has gone from famine to feast. However, if teacher production is now throttled too severly, the replacement requirements to meet normal attrition and whatever expansion is required by population growth will not be met and we shall shortly be faced with famine again.

This experience with regulating the supply of school teachers seems to me to share many aspects of our concerns in the area of graduate training and research manpower production. The nature of the problem passes a challenge to social planners, and particularly to their ability to establish the credibility of their predictions. Our society seems to frequently act too little and too late on the recommendations of planners. Social engineers are also challenged to devise methods for the regulation of supply in an orderly way, and for avoiding the seemingly inevitable brisk overreaction whenever the magnitude of an "error signal" describing the gap between reality and ideality of supply is announced. Alan Cartter, long viewed as a Casandra has recently emerged as a prophet. But college students may overreact to his forecasts with a consequent serious collapse in graduate enrollment.

Authoritarian countries are not of course confronted with severe problems of this sort, and in this country central regulation, by criteria and processes unspecified, is likely to be increasingly discussed along with the price that such a process might extract.

It seems to me that we have only begun to appreciate the range of new and unprecedented problems that will inevitably arise and confront the recently transformed enterprise of science. Since this effort is now to so large an extent the creature of public largesse and to so deep a degree dedicated to the solution of societal problems, many of the questions will have to be raised and answers formulated in the context of public policy. Dr. Bennett has taken "as far piece" down this road today.

TAB 7

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SCIENCE

Factors Contributing to Current Distress in the Academic Community

Thomas J. Kennedy, Jr., John F. Sherman, R. W. Lamont-Havers

Factors Contributing to Current Distress in the Academic Community

The growth of the NIH extramural program from 1960 to 1970 is analyzed.

Thomas J. Kennedy, Jr., John F. Sherman, R. W. Lamont-Havers

An analysis of the fiscal history of the National Institutes of Health (NIH) through the 1960's was undertaken in an attempt to explain the disproportion between the recent variations in NIH funds for biomedical research and the stress and perturbation currently experienced throughout the academic community.

The institutes and research divisions of NIH (later abbreviated I/RD) obligated more funds for the support of research each year of the decade until fiscal year 1970, when obligations declined by 5 percent, and an increase in appropriations for the next fiscal year has permitted obligations in excess of those for 1970 by about 15 percent. The distress of the academic community, however, is due to quite tangible constraints and dislocations imposed by three principal factors: sudden deceleration of program growth; inflation, sometimes exceptional in the biomedical sphere; and marked variations in the funding of NIH components, each receiving separate appropriations from the Congress.

During the decade, there have been a number of organizational changes, such as the creation of new institutes and divisions—National Institute of General Medical Sciences (NIGMS), Division of Research Resources (DRR), National Institute of Child Health and Human Development (NICHD), National Institute of Environmental Health Sciences (NIEHS), National Eye Institute (NEI), and Division of Regional Medical Programs (DRMP)—both newly established and as a result of internal reorganization; the separation of components from NIH—DRMP and National Institute of Mental Health (NIMH); and the addition of new components—Bureau of Health Manpower Education (BHME) and National Library of Medicine (NLM). All fiscal data included in this report have been adjusted for these changes to ensure consistency and compatibility.

Budgetary History

The NIH budget from fiscal year 1960 through 1970 is presented in the aggregate, with several subsets that are of interest (Table 1).

1) Many of the tabulated data are derived directly from budget activity schedules and are self-explanatory: regular research grants, special program grants, general research support grants, research contracts, training grants, fellowships, and research facilities construction grants.

2) The total of these obligations—extramural program (I/RD)—is a comprehensive measure of current operating support to grantee institutions and of long-range capital investment in their people (through training awards) and their space (through construction grants).

3) Obligations for academic science include research, training, and facilities awards to academic institutions.

4) A subset of these—awards to medical schools by the institutes and research divisions of the NIH—is available only from fiscal year 1967 to date. Prior to that time, the series included awards to medical schools from NIH as well as the current components of the NIH. The formidable clerical task of stripping out the former data from the time series has not been completed. The combined NIH-NIMH data from fiscal 1960 to 1970 is still of consider-

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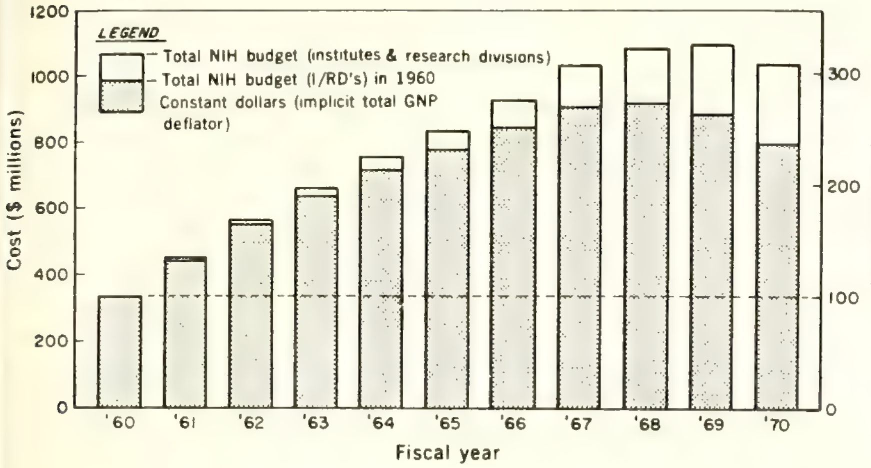

Fig. 1. Total NIH obligations: institutes and research divisions, 1960–70.

able interest and hence is included in Table 1.

In Table 2, major elements from Table 1 have been selected and normalized to reflect fiscal year 1960 as representing 100. The general patterns of growth are discernible, although the fairly large composites presented here tend to obscure the more precipitate changes in some of their elements visible in Table 1. For example, the category of special program grants began only in the decade covered and grew rapidly and steadily until recently, whereas health research facilities grants had a meteoric decline.

Figure 1, derived from Tables 1 and 2, illustrates the patterns of growth. The aggregate growth in actual dollar level of most of the tabulated activities was steady and positive until about fiscal 1967. Since then, changes have been small. Most elements decreased in fiscal 1970.

Toll of Inflation

Fiscal obligations are the most readily available index of the principal mission of the NIH—the support of the nation's biomedical research program. The basic program elements, such as people, institutions, and projects, are complex mixes, and it is difficult to find simple and meaningful characteristics that can be accurately measured. Obligations, however, reflect at least roughly the level of program activity supported and can be refined further to approximate the real state of affairs by taking into account several factors that modulate the extent to which total obligations are indicative.

One refinement is to correct dollar growth for simple price inflation. The implicit price deflator for the total gross national product (GNP) is used throughout this article to convert "current" to "constant" dollars (see Table 2 and Figs. 1–3). By this index, price inflation was modest until 1967, averaging about 3 percent per year. Annual increases thereafter have been between 5 and 6 percent.

The activities supported by the NIH, such as research and research training, include salaries of research and other personnel as their major (60 to 75 percent) cost element. There is evidence that salary scales have risen at rates considerably in excess of general price inflation.

Each year, the Association of American Medical Colleges solicits and publishes data on the median salaries of "strict full-time" faculty (*1*). Between 1964 and 1970 the annual compound rate of increase in salaries for all faculty positions in eight clinical science

Table 1. NIH obligations for various budget categories, fiscal years 1960–70 (in millions of dollars).

Budget category	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Total budget (I/RD)*	337	451	566	662	756	837	929	1034	1085	1095	1038
Total extramural program (I/RD)	283	383	499	574	656	729	806	909	947	946	881
Total extramural research	192	265	364	414	474	519	579	684	719	728	702
Regular research grants	163	202	266	305	351	370	402	444	456	455	437
Special program grants †	10	27	49	41	52	56	79	104	111	116	110
General research support grants		13	18	26	30	39	39	45	54	53	50
Research contracts	20	23	31	36	41	54	58	90	97	105	105
Training grants	49	70	77	86	98	106	124	134	135	142	131
Fellowships (and career awards)	13	18	23	30	35	40	45	49	52	55	48
Research facilities construction	29	30	36	50	50	65	59	42	41	22	0
Total academic science (I/RD)	211	292	372	434	492	554	610	690	710	724	647
Research	137	189	255	292	338	372	413	483	510	529	486
Training and fellowships	54	77	88	103	115	127	148	163	166	176	161
Facilities construction	20	27	29	39	39	55	49	35	35	19	0
Total medical school academic ‡ science (NIH and NIMH) §	145	209	280	302	357	397	439	482	478	508	483
Research	92	131	195	207	241	262	287	325	314	348	338
Training and fellowships	40	58	65	79	94	103	121	138	142	154	145
Facilities construction	14	21	21	16	22	32	31	18	22	6	0
Total medical school academic science (I/RD)	NA‖	NA	NA	NA	NA	NA	NA	436	429	452	425
Research	NA	NA	NA	NA	NA	NA	NA	308	295	327	315
Training and fellowships	NA	NA	NA	NA	NA	NA	NA	110	112	119	110
Facilities construction	NA	NA	NA	NA	NA	NA	NA	18	22	6	0

* Total budget excludes foreign currency program (P.L. 480). † Special program grants includes P.L. 480 funding. ‡ Includes schools of osteopathy for 1969–70. § Includes I/RD's, BHME, and NLM. ‖ Figures not available.

Table 2. NIH obligations for various budget categories, fiscal years 1960–70, in current and 1960 constant dollars, normalized to 1960 = 100. The implicit price deflator for total gross national product (GNP) (1960 = 100) is utilized to convert current to constant dollars. Normalized constant dollars are shown in parentheses.

Budget category	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Total budget (I/RD)	100	134	168	196	224	248	276	307	322	325	308
	(100)	(132)	(164)	(189)	(213)	(231)	(250)	(270)	(272)	(262)	(236)
Total extramural progam (I/RD)	100	135	176	203	232	258	285	321	335	334	311
	(100)	(134)	(172)	(195)	(220)	(240)	(258)	(282)	(283)	(270)	(238)
Total extramural research	100	138	190	216	247	270	302	356	374	379	366
	(100)	(136)	(185)	(208)	(234)	(252)	(273)	(313)	(316)	(306)	(280)
Training grants	100	143	157	176	200	216	253	273	276	290	267
	(100)	(141)	(153)	(169)	(190)	(202)	(229)	(241)	(233)	(235)	(204)
Fellowships (with career awards)	100	138	177	231	269	308	346	377	400	423	369
	(100)	(138)	(169)	(223)	(254)	(285)	(315)	(331)	(338)	(338)	(285)
Total academic science (I/RD)	100	138	176	206	233	263	289	327	336	343	307
	(100)	(136)	(172)	(198)	(221)	(245)	(262)	(287)	(284)	(277)	(235)
Total medical school academic science (NIH and NIMH)	100	144	193	208	246	274	303	332	330	350	333
	(100)	(142)	(188)	(201)	(234)	(255)	(274)	(292)	(279)	(283)	(255)

departments and in basic medical science departments was 6.0 percent. The annual rate of growth ranged from 4.4 percent for chairmen of departments of psychiatry to 8.1 percent for associate professors of radiology. The overall increase in faculty salary rates clearly exceeded that of simple price inflation, as demonstrated in Fig. 2.

In September 1970 the staff of the National Cancer Institute (NCI) surveyed a sample of five important grantee institutions (and 12 major NCI contractors) to obtain data on changes in the cost of performing research during the period 1968–70. Grantee institutions reported annual increases of 6.8 percent for salaries, 7.3 percent for supplies, and 7.7 percent for equipment. Salaries accounted for 60 percent of their research costs.

The rapid increase in faculty and research salaries could reflect inflationary pressure occasioned by the rapid infusion of federal research funds. Evidence that salary increases in cognate areas approximate what could be expected from simple price inflation (base salary × GNP deflator) would tend to support this hypothesis.

Data collected by the Internal Revenue Service (IRS) (*2*), however, indicate that the professional income of physicians (either in solo or partnership practice) has escalated much more rapidly than price inflation and a little more rapidly than the salaries of medical school faculty (Fig. 2). These data suggest that the primary force pushing up academic faculty salaries has been competition for medical personnel in short supply rather than the increase in funds for research, reflecting the reality that medical school salaries must be competitive with income from the practice of medicine if the schools are to recruit and retain clinical faculties.

Although no comprehensive data are available on biomedical research salaries in industry, the NCI data mentioned above indicate comparability with the IRS data on physicians. The NCI contractors reported annual increases of 8 percent for salaries and 4 percent for supplies and equipment. Salaries accounted for 70 percent of their research costs. Again it would appear that salaries in areas comparable to, but little affected by, NIH programs have mounted faster than costs in general, contributing to the stresses on the academic community.

Several other items that constitute substantially large cost elements in research budgets should be identified as taking a toll probably in excess of that reflected in simple price inflation.

A measure of hospital cost increases may be gained from NIH experience in supporting clinical investigation. Special research grants for the support of general and categorical clinical research programs account for a significant portion of NIH research expenditures. An additional large amount of clinical investigation is performed under regular project grants, where patients hospitalized in "scatter beds" are studied. Over the last 5 years, the General Research Center program alone has supported an

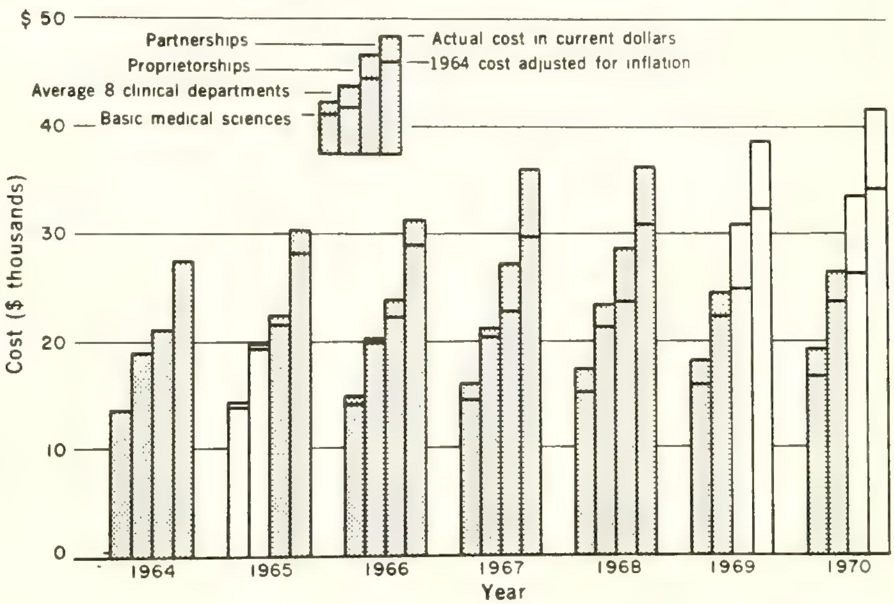

Fig. 2. Comparison of medical school faculty salaries (*1*) with net incomes of practicing physicians (*2*). Actual average figures are shown, with the exception of medical school faculty salaries for 1965 and net incomes of practicing physicians for 1969 and 1970 (blank bars). For these years, approximate figures are based on the average annual growth rate of 6.0 for faculty salaries between 1964 and 1970, and of 8.0 and 7.2 for net income of physicians in proprietorships and partnerships, respectively, between 1964 and 1968. Values for 1964 costs adjusted for inflation were obtained by applying the total GNP deflator to the 1964 base for each category.

Table 3. Growth in direct costs of general clinical research centers, fiscal years 1965–70.

Budget category	Cost in dollars					
	1965	1966	1967	1968	1969	1970
Personnel*	45	48	55	63	71	
Hospitalization*	41	46	50	56	63	69†
Other operating expenses	4	4	4	4	4	
Total direct costs*	90	98	110	122	138	

* Cost per patient day. † Calculated on 80 centers in 1970 after 13 centers were closed. Comparable data on personnel costs not available.

average of about 1000 beds (or a capacity of about 365,000 patient-days of hospital experience). Table 3 illustrates the increase in the direct costs of operating General Clinical Research Centers, which include the costs of faculty, nurses, other patient-care personnel, and hospitalization. Together these account for about 95 percent of the direct costs incurred by the centers. Figure 3 illustrates the national average growth in daily service charges of all hospitals between 1960 and 1970 (*3*). Clearly, the toll here far exceeds that of general inflation.

The growing complexity of science has not only stimulated the development of increasingly complex instrumentation, but has also been a consequence of such development. Indeed, the fact that new instruments make possible the measurement of new properties of systems leads to the formulation of hypotheses that would not have been seriously advanced or even conceived in the absence of appropriate measuring devices for testing them. Progressive improvement in instrumentation has occurred, for example, in the field of microscopy, and has entailed considerable increases in cost. The digital computer, to mention another example, has come to play a large role in biomedical research in the last decade. While costs for performing routine calculations have been reduced, greatly increased costs usually attend research in which the computer becomes an integral part of the instrumental ensemble, permitting execution of experimental procedures otherwise impossible.

The period since World War II has been one of rapid expansion of the national as well as federal investment in research. This growth has brought large numbers of young investigators into the biomedical sciences. As these scientists mature and assume increasing responsibility, salary increases occasioned by promotions and advancement in faculty rank are superimposed on basic salary adjustments for cost of living or price inflation or both. This phenomenon has consumed a substantial part of the increments in NIH obligations.

Toll of Indirect Costs

In the domain of research, the indirect is as real and necessary a cost as the direct. Indirect costs have posed a difficult problem for many years. In the early days, when the level of NIH support was low, project research could usually be accommodated within a grantee institution's existing program activities, and the incremental overhead costs were small. As research assumed larger proportions, however, arbitrary federal limitations on reimbursement for indirect costs resulted in more significant burdens on performing institutions.

In lieu of reviewing the long and involved history of this issue, the following summary may be made. With respect to research project grants, the NIH from 1955 to 1963 limited overhead to 15 percent of total direct costs. In 1963 the limit was fixed at 20 percent of allowable direct costs, which in practice worked out to about 16 percent of total direct costs. In 1966, in a major policy shift, the NIH began to pay full indirect costs and to require grantee institutions to share with the government in the total cost of each project. The basis for the rise in indirect costs is complex and not well understood. Several factors have been implicated, but not clearly defined, nor has their relative importance been assessed. They include better identification of costs through more effective systems for grantee management, as well as inflation.

Table 4 shows the direct, indirect, and total amounts awarded in research grants from 1965 to 1970. Total costs under grants have grown faster than direct costs, reflecting the rapid rise in indirect costs during the past 5 years. The rate of increase in total costs—a less accurate index of program activity than direct costs—overstates the rate of increase in program level. While the NIH favors payment of full indirect costs to grantee institutions, implementation of this policy reduces the amount of research that can be purchased at any given level of funding. If this reduction alone is added to the toll taken by inflation, the level of program activity for 1970 as reflected by direct costs is well below that for 1965. Thus, the decade of the 1960's saw an impressive rise followed by a sharp decline in the actual quantity of biomedical research supported by the NIH.

Table 4. Growth in indirect costs of research grants of the ten NIH institutes, fiscal years 1965–70, excluding NIH grants for general research support, general clinical centers, animal centers, and other special research resources administered by the Division of Research Resources. Total direct and indirect costs and total awards are shown in millions of dollars.

Budget category	1965	1966	1967	1968	1969	1970*
Total direct costs	332	370	410	411	399	379
Normalized to 1965 = 100	100	111	123	124	120	114
Total indirect costs	54	63	80	92	101	104
Normalized to 1965 = 100	100	117	148	170	187	193
Total awards	386	434	490	503	500	483
Normalized to 1965 = 100	100	112	127	130	130	125
Indirect costs (percent of direct)	16	17	20	22	25	28

* 1970 estimates = funds available for obligation; excludes OMB reserves.

Pressure of Expanded Research Potential and Need

Curtailment of available funds has coincided with an expanded potential for research, generated by the growth of grantee institutions, programs, and the pool of candidate investigators. The full measure of the pressure resulting from this potential is not necessarily reflected in the volume of applications for research grants, because express demand tends to track availability of

funds and to shrink in the face of tight budgets.

The number of trained scientists qualified for and expecting careers in biomedical research has grown remarkably in the last decade. Data from the U.S. Office of Education (*4*) show that total graduate enrollment in the biosciences increased from 14,774 to 34,861 between 1960–61 and 1970–71. The number of Ph.D. degrees conferred in these same disciplines increased from 1193 to 3418 (*5*). Cumulatively, a substantial number of doctoral-level scientists have been added to the research manpower pool over and above what could have been foreseen from 1960-level activity. Many of these have joined the nationwide competition for research support.

A parallel growth has occurred in the number of physicians who have received research training experience during the course of their postdoctoral education and have since sought support for independent research. Enumeration of this group is difficult because it is not subject to a labeling procedure, as is the award of a doctorate. Between 1963 and 1970 the NIH supported, through the mechanism of training grants and fellowships, an annual average of approximately 4500 physicians. Almost four-fifths of those were fellows and full-time trainees. Past experience indicates that about half terminate training each year and, if opportunities arise, enter research rather than medical practice.

The number of institutions awarding advanced degrees has expanded. Since research is *the* method of graduate education in the sciences, these institutions have, by their very existence, expanded the competition for available research funds. In the 1960's, about 20 new medical schools were created in this country. Each has recognized that a modern science-based medical curriculum demands a vigorous, high-quality research program of at least modest proportions.

During the 1960's a large number of problem areas potentially amenable to scientific approaches emerged, and many of them come within the purview of the NIH. Notable are population, mental retardation, human development, environmental hazards, child health, alcoholism, drug abuse, occupational health and safety, and the organization and delivery of health services. Each of these fields is in competition for health research funds.

Role of Organizational and Managerial Factors

Changes in the overall NIH budget and the impact of such changes on the aggregate level of supported research provide only a partial description of factors which NIH introduced and which bear directly on the academic biomedical research community. Superimposed on the aggregate and average effects on research are specific events resulting from: interplay among the overall policies and procedures of the NIH, the individuality of each of its component institutes and the consequent inter-institute variability, and externally imposed rigidities and transients. The impact of these factors may be experienced with disproportionate severity by certain constituencies, and individuals or institutions may perceive incomprehensible inequities.

Yet the occurrence of unusual events from time to time can only be expected in view of the magnitude, diversity, and complexity of the effort conducted by the NIH. The research component of the agency operates with 12 separate appropriations; processes about 8000 competing research grant proposals each year, not to speak of applications for about 7500 noncompeting research grants, about 3000 graduate training grants, and about 6000 fellowships and career awards; and utilizes 50-odd study sections plus a roughly equivalent number of other initial review groups to evaluate proposals. The challenge of coordinating this vast process of fund allocation resides in the fact that the purposes for which support is sought are discrete yet highly interrelated.

In the overall governance of the NIH, a style of operations which developed over the last quarter-century forms a backdrop that should be kept in mind in examining specific causes of distress in the academic community.

Research grant applications submitted to the NIH are processed through three screens: one for NIH-mission relevance by the NIH staff; one for scientific priority by study sections; and one for program priority—pertinence to the individual missions of the supporting institutes—by the national advisory councils. The study section review accords a numerical score to each application deemed worthy of an investment of federal funds; the advisory council action modifies that assessment in a variety of ways by introducing what amounts to a weighting coefficient. Recommendations emerge from the review process on the appropriate funding and duration of each project. The order of payment of approved applications is determined by the modified priority score.

There are three cycles of review in each fiscal year. Institute directors with the advice of their national advisory councils must develop a strategy for obligating equitably the funds appropriated, with a view to supporting the most meritorious of the approved applications whenever received during the fiscal year.

More than two decades ago the NIH established a policy of funding out of current-year appropriations only the first year of a multiple-year award, and of according to continuation applications under these awards the first claim on funds appropriated in subsequent years. These continuations were re-

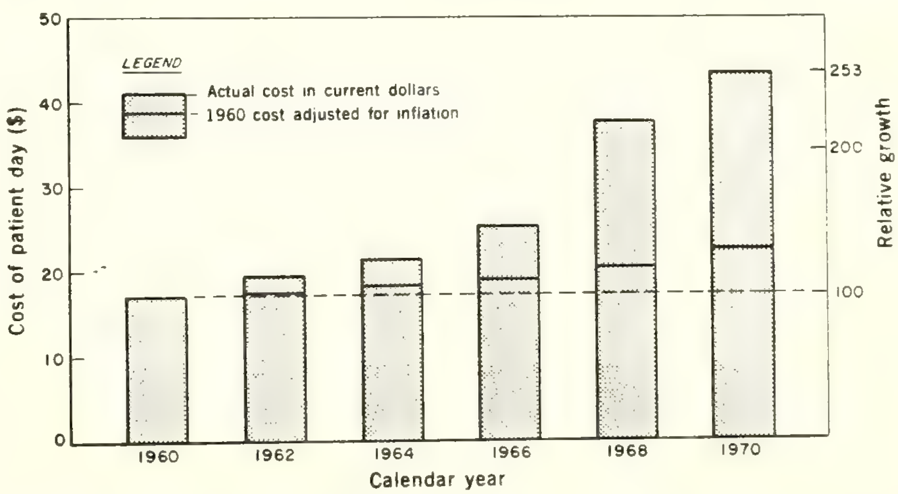

Fig. 3. Growth of hospitalization costs, 1960–70; national average of daily service charges per patient (adult patient, two-bed room, short-term stay) (*3*).

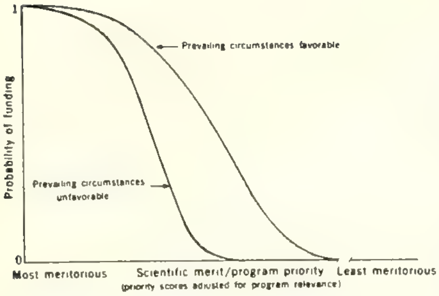

Fig. 4. Probability that an approved competing proposal will be funded.

garded as moral commitments. The discretionary funds available to an institute in any given year are those remaining after the moral commitments have been honored.

As a matter of sound management, the NIH staff, through periods of committed support, has negotiated awards upward or downward as warranted by progress in the conduct of a project and within limits established by the national advisory councils. Such negotiations are in no way incompatible with the policy of honoring moral commitments.

The NIH has sought continuously, within limits imposed by the review process, to expand the number of institutions engaged in biomedical research. As a consequence, an examination of the distribution of NIH research support among institutions reveals a heavy concentration of funds in a relatively small number of institutions characterized by general excellence in science, together with a very broad dispersion of relatively small amounts of funds to a large number of institutions. During periods of fiscal retrenchment, institutions with modest support are vulnerable in many ways, and over the last few years a number of them have lost all NIH funding.

Since 1937 a series of legislative and administrative actions have expanded the single National Institute of Health to include ten categorical institutes and several research divisions under the umbrella of a central administrative organization known as the National *Institutes* of Health. The cumulative effect has been to transform a small federal laboratory into an agency that accounts for more than half of all federal, and about a third of all national, support for biomedical research. Funds are appropriated by the Congress each year to the individual institutes, not to the umbrella organization; and transfer of appropriated funds from one institute to another is for all practical purposes impossible. Each of the institutes has a unique history and growth pattern of its own.

A more detailed examination of the factors that account for the variability between institutes, and a more specific illustration of the consequences of these variations on individual investigators, grantee institutions, and fields of science, will help to illuminate the phenomena that are causing distress.

Growth patterns in obligations by the individual institutes have varied significantly. In the past, almost three-fourths of the total funds available to an institute for research grants has been used to honor committed continuation projects; only the remainder has been available for competing applications. The funds awarded for noncompeting applications have tended to increase annually for almost every institute. Hence, for the several institutes whose total funds available for obligation declined, there was a disproportionately severe decrease in the support for competing projects (Table 5).

The noncompeting funding requirements are analagous to the obligations categorized as "uncontrollable." They are made up not only of moral commitments in the usual sense of the term, but also of grants in support of complexes called "centers" and "resources." The programs, emphasized in recent years, that these instruments support are broad, the objectives long-range, and the fiscal requirements large. Thus, resources and centers once initiated are more likely than regular projects to be sustained in subsequent competition for renewal.

Table 5. Research grant awards from four institutes by type of grant, fiscal years 1967 and 1970.

Institute	Millions of dollars				Percent of total for competing	
	Noncompeting funds		Competing funds			
	1967	1970	1967	1970	1967	1970
NICHD	24.0	26.9	12.8	13.2	35	33
NIAID	29.0	32.0	17.5	17.1	38	35
NCI	48.5	53.9	22.1	17.5	31	25
NHLI	68.7	66.4	27.7	20.0	29	23

Table 6. Percentage of research grant funds from the ten NIH institutes, by type of grant, fiscal years 1967–70.

Year	New	Renewal	Noncompeting	All
1967	23	9	23	21
1968	23	17	24	23
1969	19	22	26	25
1970	16	25	28	26

The cost of sustaining these large projects has risen each year. Since the total research grant funds available to the ten institutes and the Division of Research Resources have been relatively constant for the past several years, an increasing proportion of those funds would be expected to go for support of the large projects, not because of recent new starts but merely to sustain existing programs. Table 6 shows the percentage of each type of research grant funds.

The net effect of these commitments to grants for resources and centers is to increase the uncontrollable expenditures and to decrease the discretionary funds for new and renewal awards. The level of available discretionary funds varies from institute to institute and from year to year; it reflects, in part, conventional moral commitments and, in part, the unique history of each institute's utilization of centers and resources to achieve its specific mission.

Recently a smaller proportion of new grant funds has been awarded for program projects and centers, indicating a shift to the support of regular (and less costly) research projects. The rate at which this general trend is occurring varies from institute to institute. It is largely dependent on the extent to which the organization is involved in long-range commitments and the options open to it to modify its approaches in the light of the probable consequences of a policy change.

As the program scope of the several institutes has evolved, some have tended to become increasingly the major source of support for specific fields and disciplines. Thus the fortunes of those domains of science and the "patron" institutes tend to rise or fall together.

Other disciplines and fields derive support from several categorical institutes. Thus, with differential growth in institutes, investigators of equivalent

caliber may experience different success in obtaining support, reflective of the fortunes of the institute within whose program scope their work falls. Oncogenic virology, for example, will probably fare better than virology in general for the next few years as a result of the rapid growth in funds for cancer research.

Certain grantee institutions, especially free-standing research organizations with a heavy categorical focus, come to derive the major fraction of their total support from a single institute. Grantee institutions with small total support, based on isolated islands of scientific excellence, also tend to be funded by a single institute. Here again the fortunes of a grantee institution and an institute become coupled, and the special vulnerability of the grantee institution in times of fiscal constraint is obvious. In the years 1967 to 1970, the total number of institutions of higher education receiving NIH research grants declined successively from 330 to 316, 299, and 277.

The fate of a particular competitive application is dependent not only on funds available to support it but also on the amount of competition it must face within the institute to which it is assigned. At any time, the total flow and distribution of new, competing renewals and noncompeting continuation grants differ for each institute and may depart significantly from the aggregate pattern for the NIH as a whole.

Each of the approximately 50 study sections has a discrete pattern of response to the new and renewal applications it reviews. Since the study sections tend to be organized along disciplinary lines, and the institutes along lines of categories of disease, each study section reviews applications assigned to many institutes (though most are related to a few institutes). The result is that the approval rates which the initial review groups (IRG's) accord a group of applications vary by institute and over time.

Approval rates of renewal applications have been consistently greater than have those of new applications. This is to be expected, since each renewal application represents a project that once competed successfully as a new application. The winnowing process has already selected the applicant as a more promising investigator than his unsuccessful former competitors. In the context of this discussion, the fate of an application, viewed statistically, is related to whether it is a new or renewal proposal.

Table 7. Number of competing and noncompeting grants of the ten NIH institutes, fiscal years 1962–70.

Year	Competing	Noncompeting	All projects
1962	4,573	7,509	12,082
1963	4,387	8,144	12,531
1964	3,966	8,475	12,441
1965	3,766	8,457	12,223
1966	3,494	8,476	11,970
1967	3,879	7,992	11,871
1968	3,023	8,092	11,115
1969	3,324	7,596	10,920
1970	2,605	7,226	9,831

The variable pattern of IRG behavior is reflected not only in approval rates but in the distribution of priority scores for approved applications. Moreover, within a single IRG, dynamic trends are occasionally discernible as the membership changes, as the field matures or goes into eclipse, or as other forces supervene. The net result is further inter-institute variation in the scientific-merit priority scores.

Each institute has a distinct mission or missions, usually categorical, as in cancer, heart, or arthritis. Therefore, its program director, with the assistance of the members of its national advisory council, must develop a plan for attaining the central goals of the organization. This strategy results in emphasis on certain fields or disciplines or areas of science. Thus, proposals of roughly equivalent scientific merit (understood in the light of the previous discussion of variation in IRG behavior) are adjudged as more likely to advance the missions of an institute if they are in certain fields. Conversely, applications of equivalent merit from a specific field are likely to be assigned different program priorities by different institutes. Thus, in each cycle of review, the number of competing applications received by a given institute varies absolutely and in relation to that of other institutes. Moreover, the prospects of award are modulated by complex influences exerted by study sections, national advisory councils, and institute program objectives.

Table 8. Funding rates for new and renewal research grant proposals, National Institute of General Medical Science (NIGMS) and all NIH institutes, fiscal years 1967–70 (percentage of IRG-approved proposals funded).

Fiscal year	New proposals (%)		Renewal proposals (%)	
	NIGMS	NIH	NIGMS	NIH
1967	53	74	67	80
1968	29	57	46	73
1969	49	63	68	70
1970	13	42	32	60

External Limitations

From time to time unexpected interruptions, limitations, and contingencies arise to create managerial problems.

Occasionally an item in a budget is earmarked for a narrow, highly specific objective. This dedication of funds may occur within the Executive Branch during the development of the President's budget or may be imposed by the Congress. The effect is an expansion of uncontrollable expenditures and a reduction of funds for flexible and discretionary use. By its very nature, limitation of this sort can have an impact that may well seem capricious.

The NIH grew at a rather steady rate for many years, and its procedures and processes were based on and geared to such a growth pattern. Patterns of experience, expressed in operating statistics, for projecting future management of the agency's responsibilities necessarily reflected this history. The relatively sudden cessation of growth which began in the late 1960's required adjustments to a new set of expectations, reexamination of the total set of policies that had developed since about 1950, and decisions on long- and short-range modifications of policies, procedures, and practices. Action pursuant to such decisions tended to be applied in situations already scheduled for action according to existing timetables—for instance, competing grants—rather than across the board, in order to avoid destabilizing the entire biomedical research community. Thus, as noted above, a shift away from emphasis on long-term grants was first manifest from action on new and renewal grant applications, but the full extent and impact of this trend will not be apparent until all grants of this type reach the end of their project period and reenter national competition. Since each institute has different requirements and thus different proportions of such grants, and somewhat different expectations, the pace and extent of change have varied.

From fiscal year 1962 through 1968, the research grant funds awarded by the

Table 9. Factors determining whether a scientifically meritorious competing proposal will or will not be funded by the NIH.

Extrinsic to the NIH

Proposal relates to program with a large/small public constituency.

Related to program having/not having presidential, congressional, or departmental priority.

Line item/no line item in budget for program.

Submitted during period of rapid growth/stability or decline in funding institute.

Intrinsic to the NIH

Processed by a study section disposed to give high/low priorities.

Area of high/low institute program priority.

Competing renewal application/new application.

Submitted to a funding institute with a small/large number of long-term commitments (centers, program projects) and relatively great/little flexibility.

Funding decision coincident with time when many/few options are open within annual funding strategy of patron institute.

Related to a field or discipline widely regarded as undersupported/oversupported in scientific or program terms.

Proposal relatively original/unoriginal; comparable ones are not/are in competition; little/much related work in progress.

ten research institutes (or their predecessor units) increased steadily from $332 million to $503 million. In 1969 and 1970 the total amount decreased somewhat, reaching $483 million. Table 5 indicates the trends in the number of competing (new and renewal) and noncompeting projects supported by the ten institutes.

Competing awards declined sharply between 1967 and 1970. The year 1969, however, was exceptional, probably because the NIH, faced with what was first thought to be a transient curtailment of funds, decided to modify its policy of moral commitments and to negotiate all noncompeting awards downward to an average extent of 10 percent beyond normal negotiations required by sound management. This action was intended to maintain as many investigators as possible through a period of crisis. Moreover, the NIH could not have reasonably complied with the ceiling on expenditures imposed by the Congress through the Revenue and Expenditure Control Act of 1968 (P.L. 90-364) without limiting the obligations for noncompeting grants.

In the following year, the attenuation of growth seemed likely to continue. Hence, the NIH decided to curtail arbitrary across-the-board negotiations and to resume insofar as possible its long-standing policy of supporting projects with the highest program priority minimally but adequately, relegating to a secondary role the objective of maintaining stability throughout the biomedical research community.

The fiscal stringency experienced since 1969 has exposed previously masked consequences of the early NIH policy decision to support research through the funding of individual project proposals. In essence, a project system embodies the principle of cost reimbursement: the amount awarded reflects the best peer judgment of the reasonable costs required to complete work of the scope proposed. Thus it makes little sense to provide less than full support, notwithstanding the impulse to spread available funds among all approved proposals during times of fiscal stringency. Recognizing this, the NIH proposes to all but eliminate arbitrary negotiations of moral commitments by fiscal year 1972.

The experience of 1969 illuminates the fact that two NIH policies, both widely regarded as highly desirable—to honor moral commitments and to fund approved applications by rank order of program priority—while quite compatible when budgets are rising, come into sharp conflict under contracting fiscal circumstances. It also reveals that honoring moral commitments increases the uncontrollables and thus restricts during periods of fiscal stringency the funding of new or renewal projects of equivalent scientific but higher program priority.

Between 1962 and 1968 other factors that contributed to the reduction in the number of projects were the trend toward larger projects in which several small ones were consolidated, and the more rapid growth in the unit cost of research than in funds available. This situation was brought about because of inflation, technological complexity, investigator salaries, and indirect costs.

The net result of the operation of all the factors discussed is reflected in the number of approved projects that a given institute funds. Recent trends for one of the institutes, compared here with the total experience of the NIH, reveal the pattern illustrated in Table 8. Comparable data for all the institutes show wide variation, not only in comparison with other institutes but from year to year. Even the cumulative effect for the entire NIH shows striking changes over a period of only 3 years.

In the light of this analysis, it is possible to outline the circumstances under which an application of high intrinsic scientific merit would have the greates or least probability of funding (Table 9).

The abstract graphic representation

Table 10. Summary of NIH research obligations by program, fiscal years 1970–72 (estimated). Budget authority in millions. Excludes P.L. 480 programs and NIMH portion of general research support grants.

Institutes and research divisions	1970 (comparable)	1971 (estimated)	1972 President's budget (final)
Total budget (I/RD)	$1,012.5*	$1,166.3*	$1,291.8
Allergy	94.1	98.1	99.3
Arthritis	128.4	134.4	135.4
Biologics standards	7.9	8.7	9.0
Cancer	179.0	230.5	234.3
Child health	75.4	93.7	103.2
Dental	28.3	34.7	38.8
Eye	24.2	30.4	32.6
Environmental health	17.2	20.0	25.3
Fogarty International Center	3.2	3.7	3.3
General medical sciences	142.9	154.5	150.4
Heart	156.7	191.6	195.5
Neurology	92.7	99.5	96.5
Research resources	62.7	66.4	68.1
Cancer conquest program			100.0

* Reflects comparative transfer of $23 million from the institutes to BHME for research training grants.

in Fig. 4 indicates that at any given state of NIH affluence, an application of given priority will encounter a range of probabilities of funding depending on a number of prevailing circumstances. Most applications processed through the system encounter a mixture of factors, some enhancing, some reducing the probability of success. Rarely are the circumstances all unfavorable. Individuals, grantee institutions, or the research community in general may infer from the improbable case that the system is basically given to capricious or idiosyncratic behavior, an impression reinforced by the tendency for memories of such events to accumulate and persist.

Neither the available data nor the more subjective analysis of Fig. 4 conveys adequately the impression, strengthened by recent events, that inherent conflicts between competing and equally meritorious goals in a federal support program can become crucial when funds are curtailed. Support of innovative ideas, which tend to be risky, competes with support of lines of proven productivity; and mission relevance, with scientific merit.

Discussion and Conclusions

The data presented in this analysis identify the major bases for the concerns that have been aroused in the biomedical research community. While the total budget for research, measured in current dollars, remained about level from fiscal year 1967 to 1970, the amount of research supportable with these dollars undoubtedly declined considerably. Particularly was this true of the salaries of the professional personnel who carried out the investigations. For example, the rate of increase of salaries of medical school faculty has exceeded the toll attributable to inflation, and the NCI study indicates that this may also be true of the salaries of investigators in industry. As a consequence, the actual quantitative level of research declined even more rapidly than the direct costs measured in constant dollars (Table 4).

The leveling off of biomedical research funding coincided with an expansion of potential for research performance, attributable to an increase in the number of scientists and of institutions granting the doctoral degree, as well as to an expansion of the scope of problems viewed as appropriate for support from public funds.

The sheer magnitude and complexity of the NIH budget and the logistics of managing it have occasioned unexpected year-to-year and institute-to-institute vagaries, the impact of which becomes most apparent when operating in conjunction with budget restrictions.

The research community has experienced considerable difficulty and major disruptions in coping with these problems. Moreover, the decreases, both substantial in magnitude and relatively sudden, have occurred as other costs of operating institutions that are performing research have risen. The institutions are additionally subject to the stresses of a greatly increased demand for their special capabilities and resources.

Epilogue

In January 1971 the appropriation act for fiscal year 1971 was signed into law, and in February the President's budget for fiscal 1972 was published. The latter document indicated that the Executive Branch plans to obligate virtually all the funds appropriated for fiscal 1971.

In Table 10 fiscal 1970 obligations are compared with estimates for 1971 and requests for 1972. The data are internally compatible, but for reasons of accounting use a different format, embrace a somewhat different universe, and yield a different aggregate 1970 obligation figure than appears elsewhere in this text.

The budget of each of the institutes has increased. In the aggregate, the total estimated obligations for fiscal year 1971, measured in 1960 constant dollars, will exceed slightly the fiscal 1969 level, but not the levels of 1967 and 1968. If the Congress appropriates and the President authorizes obligation of the total budget requested for fiscal 1972, obligations for that year will match or slightly exceed the peak achieved in the 1967–68 period.

The projected aggregate increase is not uniformly distributed among the institutes. The NCI, NICHD, NEI, NIEHS, National Heart and Lung Institute, and National Institute of Dental Research would gain substantially, in both relative and absolute terms. This reflects increasing federal commitment to targeted research programs in cancer, atherosclerosis, population and family planning, dental caries, eye diseases, environmental health, and sickle cell anemia. Substantial fractions of the increases will be used, under contracts, to conduct centrally planned and managed research and development endeavors.

By contrast, the projected increases for the other institutes—the NIGMS, National Institute of Allergy and Infectious Diseases, National Institute of Arthritis and Metabolic Diseases, and National Institute of Neurological Diseases and Stroke—are uneven and modest. In constant dollars, the increase over the 2-year period will probably not compensate for inflationary reductions in program level.

The fiscal 1971 and 1972 budgets indicate that a reversal of the trends which characterized the latter part of the past decade has begun. Changes appear to be specific, not general. All of the variables of recent years must be considered in meeting the detailed impact of the budget increases anticipated for fiscal 1972.

References and Notes

1. Average salaries of medical school faculty were calculated from data reported in "Datagrams," *Assoc. of Amer. Med. Coll.* **10**, No. 10 (Apr. 1969); *ibid.* **11**, No. 6 (Dec. 1969).
2. Net incomes of practicing physicians were calculated from data reported in the following publications: *Internal Revenue Service: Statistics of Income—1964, Business Income Tax Returns* (Government Printing Office, Washington, D.C., 1967); *ibid.* for 1965 (Government Printing Office, 1968); *ibid.* for 1966 (Government Printing Office, 1969); *ibid.* for 1967 (Government Printing Office, 1970); *Preliminary Statistics of Income—1968, Business Income Tax Returns* (Government Printing Office, Washington, D.C., 1970). These data were based on preaudited, stratified samples of individual income tax returns, Form 1040 (proprietorships), and partnership returns of income, Form 1065 (partnerships).
3. Data were abstracted from *Daily Service Charges in Hospitals, 1960 through 1970* (American Hospital Association, 1961 through 1970).
4. *Students Enrolled for Advanced Degrees: Institutional Data, Fall 1969*; Office of Education 54019-69 Part B (Government Printing Office, Washington, D.C., 1970).
5. *Doctorate Recipients from United States Universities, 1958–1966* (National Academy of Sciences–National Research Council, Washington, D.C., 1967); *Doctorate Recipients from United States Universities: Summary Report 1970* (National Academy of Sciences–National Research Council, Washington, D.C., 1971).

BASIS FOR DETERMINING
RESOURCE ALLOCATION FOR BIOMEDICAL RESEARCH*

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Society's expectation from research in the biomedical sciences is the solution or amelioration of problems that threaten life and health. While modern medical science has made tremendous progress, tremendous problems remain--problems that tragically limit personal fulfillment and achievement. The direct cost of disease, about $~~70~~ 75 billion per year, represents only the most visible expense. Indirect costs, judged by measures such as lost productivity, are enormous and even then fail completely to reflect the grave psychological and social burden of illness to individuals and their families.

In the last decade or two, public attention has focused on serious problems concerning the quality, accessibility and costs of health care, the financing mechanisms, and the availability of health manpower and facilities. But delivery capability can be no better than the current state of knowledge. The latter is completely determined, and limited, by the effectiveness of research. Thus it is important to examine the determinants of resource allocation for the medical research effort.

Biomedical Research and Social Goals

Direction of research toward certain objectives does not automatically result in their attainment. Research is a complex activity that must be

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viewed in terms of the individuals who perform it, the institutional settings in which they work, the resources available for the task, and the current state of knowledge in the specific research area.

Discoveries come in a variety of forms, from generalizable conclusions that illuminate large segments of biology and medicine to specific findings of narrow applicability. Interplay between these enables some creative scientists to discern universals in the mass of detailed data, and others to discover the applicability of broad principles to a specific problem area. Thus inductive and deductive processes lead to new and creative syntheses, theories and applications.

Realization of society's expectations depends on the extent to which individual research workers, institutional research performers, and resource allocation processes can be aligned with social goals. The last quarter century has seen the forging of machinery capable of converting society's expectations of biomedical research to reality. This has been achieved principally through steadily rising Federal support, the creation of a national network of scientific capabilities and institutional commitments, and the development of the National Institutes of Health as the lead agency.

National expenditures for health research have increased from a token level of $87 million in 1947 to approximately $3 billion in 1971--a growth rate of 16 percent a year. This growth has been paced by rising Federal investment in health research, which grew at the rate of 20 percent a year, mounting from $27 million in 1947 to $1.9 billion in 1971. Both

the national and the Federal research investments seek solutions to urgent health problems, such as cancer, heart disease, mental illness, congenital abnormalities, family planning, child health, aging, and environmental pollution. Scientists in government, industry and the nonprofit sector--primarily academic institutions and medical schools--collaborate in the pursuit of health research objectives.

Public interest in health research has been dominated by a preoccupation with specific diseases that are highly visible, associated with high mortality rates, and often characterized by prolonged suffering or disability. Reinforced by such dramatic developments as the prevention of polio, medical research has gained strong public support since World War II. The categorical research institutes of NIH manifest governmental concern with discovering the causes of disease and developing techniques for their prevention and control.

The Issue

Against this historical background, it is clear that the emergence of the Federal Government as the dominant source of support for biomedical research has imposed key responsibility for program balance upon Federal legislators and executives. These officials must constantly seek to optimize limited resources by achieving a balance among competing approaches to the solution of research problems. In addition, they must continuously examine whether the national or Federal investments should grow, shrink, or remain stable over the periods for which long-range forecasts are attempted. Thus the specific issue posed here is, At what

level should biomedical research be supported over the next five years?

To address this issue, I propose today--

- to outline some of the analyses and arguments that have been employed to assist in a determination of appropriate levels of support for research and development;
- to describe considerations that have led to recommendations for future levels of support by the NIH; and
- to examine the processes through which such recommendations are transformed into allocations for expenditure.

Theoretical Considerations

For a little more than a decade, there has been a fairly lively literature cognate to some aspects of the issue under discussion. Perhaps the treatment of the subject had its finest hours during the period 1962-1965 when a series of stimulating articles appeared in Minerva, centering on the problem of scientific choice, and when the National Academy of Sciences commissioned a series of scholarly essays in response to questions posed by the Committee on Science and Astronautics of the U.S. House of Representatives.

This body of thought was responsive to a series of events that took place from 1940-1960. These included: the professionalization of research; its institutionalization on an unprecedented scale; the emergence of a broad consensus that the maintenance of research on the prevailing scale required substantial and continuing public support; and the recognition that research was approaching levels of public expenditure that placed it

in competition with other societal goals.

The discussion focused on a number of facets of the problem of scientific choice and led to speculation about the value of science. Attention was devoted to such problems as choice between fields of science, between "big" and "little" science, and between elements of the complex sequence *basic science/technological development/testing.*

In the efforts of the NIH to rationalize its claims on the national budget, the specification of social goals and subgoals, the criteria for ordering these, the nature and character of the value attached to them, and the metric of that value have been extraordinarily difficult to state explicitly, and therefore to use in advocacy or decision-making.

In contemporary literature, social goals appear to be valued almost exclusively in economic terms. The NIH, however, holds strongly to the position that the general goal of its research programs--*health*--is to be prized above all others in human terms. The NIH staff was gratified to note that the economic benefits of developing effective vaccination procedures against poliomyelitis considerably exceeded the costs. Nevertheless, those who are old enough to remember how the announcement of the first polio case of the season struck terror in the breasts of parents will little doubt that most Americans sought more than economic value in their generous support of polio research.

But whether the social goals are humanistically or economically based, a very distinct impression is inescapable: the predominant motivation behind public support in the United States is *utilitarian.* Scientists are expected to attain goals that are regarded as useful to the society.

An outstanding feature of this growing body of literature is the absence of any intellectually convincing algorithm for arriving at an optimal level of expenditure. Even when the context is utilitarian, a transformation of a social objective into dollar levels of support for research has remained intractable, and almost all attempts have been within narrow economic value systems.

One theme that undergirds all economic analysis is that the more basic the research problem, the more severely the private sector under-allocates research support, through imperfections in the market mechanism. Hence, as the argument runs, the public sector must assume the major responsibility for support of the most basic research, with the private sector not really expected to invest unless the state of knowledge is near the point of product realization.

The level of research investment defined in theory as optimal is that at which the marginal social benefit equals that of alternative uses of the dollar. Marginal social benefit--akin to a benefit/cost ratio--is the benefit to be had from the last dollar invested in the activity. Presumably the benefit from an additional dollar invested will change and at some point begin to fall. As soon as the marginal benefit falls below that of alternative projects, the allocation processes will switch to a new project; and this will continue until all marginal benefits are equal--that is, until the benefit from the last dollar is equal for all possible alternative projects.

The definition of optimality in economic terms fails, of course, to recognize that in the case of research on human disease, there is a

transcendent urgency to the pursuit. It could even be argued that investment in biomedical research should continue until the return actually becomes negative, rather than stop when the ratio falls below that of an alternative use of the funds.

Benefit/cost analysis assumes that a unique and unambigous monetary value can be placed on each social benefit achieved--an assumption patently untenable. It also assumes that accurate estimates of the cost necessary to achieve a given social benefit--say, the conquest of cancer--are possible, an equally untenable assumption in a very large domain of medical science.

Another line of economic argument relates to estimates of "willingness to pay." If every person's utility for health could somehow be assessed, and if his willingness to invest in his own future health could be approximated, all these preferences could be aggregated to yield a better estimate of society's wants than is reflected in Congressional appropriations.

Yet another line of economic analysis is based on the strong hunch held by most economists that research contributes positively and significantly to economic development and productivity. Presumably, the health benefits created by research affect the labor force and thus benefit the economy as a whole. The applicability of the argument, however, to predict optimal levels of research investment is tenuous. The data are soft, and the relationship is quantitatively uncertain.

Another form that this general thesis has taken is that research should be viewed as an overhead cost commanding some arbitrarily chosen fraction of the cost of the total activity. Thus, a percentage of the

value of the total output of an industry could be viewed as an appropriate research investment. With improved insight, refinement of the size of investment toward "optimality" might be possible. Accordingly, it has been suggested that some historically precedented fraction of the Nation's health expenditures be asserted as appropriate "overhead" or "skim" on future health expenditures and be diverted to biomedical research.

The principal difficulty with this approach is that it involves highly arbitrary judgment. Nonetheless, some rules of thumb that attempt to peg research investments to a cognate measurable index--total medical expenditures, gross national product, etc.--may be useful in determining the rough upper and lower bounds of the reasonableness of proposed levels of investment.

Other rules of thumb would estimate the appropriate level of research from the cost of supporting some fraction of all the available research manpower. It has been advocated, for example, that in respect to the balance between "big" and "little" science, virtually all competent U.S. scientists engaged in "little science" should receive support.

Practical Considerations

All things considered, the NIH has concluded that no theoretical basis for examining the question at issue is operationally adequate. The practical consequence of this judgment is that short- and long-range budget recommendations must be developed pragmatically. The NIH budget recommendations are developed each year in the light of three major

considerations: the *objectives* of the program; the extant and emerging *opportunities;* and the relative and absolute *limitations* on action. I should like to discuss these considerations briefly.

Objectives

The broad objectives of each appropriation--the NIH is the collective of 16 separate appropriations, 12 for research--are spelled out clearly in the documents that created each component of the organization. The National Heart Institute, for example, was created by the Congress in 1948. For a variety of reasons, its name was changed to the National Heart and Lung Institute, encompassing pulmonary disease within its purview. Major subobjectives, usually diseases within each general category, are defined by program officials and are reasonably self-evident.

In reality, each subobjective is a rather large domain and can again be subdivided, down to fields sufficiently circumscribed to reflect the efforts and interests of an identifiable group of investigators, to serve as a suitable universe for state-of-the-art assessments, and to be the context for "crystal-balling" with some credibility.

It cannot be over-emphasized that research is a risky enterprise; investments carry no guarantee of success. Cancer, for example, has not been conquered despite 34 years of expanding investments in cancer research. True, much progress has been made; cancers of certain specific types are now preventable or curable. But the next "breakthrough" is unpredictable. The crystal ball is cloudy on the question of when? by what individual? through what avenue of investigation? Thus, the NIH takes the view that

the Nation must commit itself to a steady biomedical research effort across a broad front of science.

Moreover, the complex system for biomedical research created over the last quarter century must be sustained. This system involves a network of institutions in the public and private sector. Colleges and universities dominate the latter and have become the major performers of federally sponsored biomedical research. The system includes a pool of scientific workers who are connected through a complex skein of relationships. It also includes physical facilities, prone to obsolescence, that must be renovated periodically or replaced.

The NIH, in the light of its statutory responsibilities, must be dedicated to the preservation of this network of kindred individuals and institutions. The research project grant has been an ideal instrument to ensure mission relevance and, operated in a peer-judgment review context, to control the quality of the effort.

Achievement of Federal research objectives will depend, in part, on the flow of funds into the system to permit a reasonably stable level of activity. Sharp transient funding increases can be managed unless they are very large. Decreases, on the other hand, can lead to rapid and permanent loss of key personnel, with sudden collapse of the system.

Stabilization of the system for biomedical research depends on the following factors:

- a long-term commitment by the Federal agency to a level of funding for nationally competitive project-grant research that will not be subject to capricious and unexpected fluctuations, particularly in

a downward direction;

- the availability of research-related contingency funds to be used by academic institutions to handle the transitional as well as capricious local perturbations in the career patterns of individual scholars;
- a carefully planned program for research manpower development to meet losses and growth requirements; and
- a commitment to maintain and, if appropriate, to expand the "plant capacity"--the facilities necessary to perform health research.

So long as the total system or network of research activity is stabilized, the problems of most individual institutions will probably be manageable.

The optimal balance between project grant support and institutional support is an important consideration. Obviously, too much institutional support, tending to the establishment of sinecures for research-oriented faculty, would be undesirable from the point of view of the individual, the institution, and the supporting agency. Both stimulation and quality control would tend to decline. Too little institutional support, on the other hand, would place the research-oriented faculty members and their institutions in a very hazardous position, vulnerable to sudden decrements in support due to unexpected fluctuations. Prevalence of this situation would be incompatible with a viable national research effort.

The central concern in a discussion of stability turns on the confidence of the research community in the depth, durability and predictability of the Federal commitment and in the resolve of the Government

to sustain this commitment in the face of unexpected vicissitudes.

Opportunities

With respect to research opportunities as a factor in budget formulation, it may be posited that the only patently rational basis for justifying research investments is the identification of good ideas and good people--people who have had good ideas in the past and are likely to have them in the future. The central problem is to identify these ideas and these people and to place them in proper perspective.

The search for emerging ideas is continuously underway at the NIH. The most fruitful sources are the information contained in research grant applications and grantees' progress reports. Members of the Institute staffs also contribute importantly to the identification of opportunities within their field of responsibility. And conferences, symposia, colloquia, etc., concerned with appraising the current state-of-the-art, are addressed to evaluation and direction. Each year, as budget deadlines approach, the results of this quest for ideas are incorporated into a fiscal recommendation.

For areas in which opportunities have been identified, funding recommendations are heavily conditioned by three factors: an assessment of relevance of the specific opportunity to the Nation's health; guestimates of the likelihood that its pursuit will be fruitful; and judgments on how large an effort is warranted by the intrinsic character of the opportunity under consideration. Not one of these assessments lends itself to really objective quantitative definition, and thus the NIH has come to rely heavily on the intuitive judgments of knowledgeable experts.

Limitations

The degree of freedom in construction of the budget is limited. Past commitments cannot be ignored, and each year's budget cannot be written on a clear slate. Several of these limitations deserve mention.

First, there are essentially mandatory obligations that the NIH must recognize each year. One is the *research grant* with multiyear commitments. These arise because the task proposed in most applications necessarily takes longer than a year. Roughly 70 percent of the budget for regular research-project grants is earmarked for these "moral commitments," with the residual 30 percent for new grants. Nor can this latter group be viewed as entirely discretionary; it includes many renewal applications from distinguished and productive investigators pursuing important lines of investigation precisely in the mainstream of NIH statutory missions.

The protection of earlier long-range investments is another imperative, similar to but extending beyond the period of "moral commitment." Certain types and styles of research require prolonged systematic exploration and will yield little exciting information in the interim. Continuance of these studies must be ensured until they have settled the issues they were designed to resolve.

The intramural research laboratories and clinics of the NIH, an extraordinarily fine center of biomedical research, cannot be subjected to rapid and capricious fluctuations without severely compromising its effectiveness. With unstable support, the attractiveness of the scientific

environment would be reduced and many of the most able members of the staff would soon leave. Moreover, good management recommends full use of the available laboratory space, built at great expense and useful for little but laboratory research.

This is not to say that the intramural program is a sacred cow that cannot be touched. Considered accommodations are always possible, and indeed constantly occur as part of the natural development of programs. Still, the intramural research must be accorded an extremely high priority claim on budgetary resources.

Inflation also has to be recognized as an important factor, for which the fixed commitments of the NIH must be adjusted. Since about 1967 the impact of inflation has substantially eroded the amount of research that can be conducted at any given dollar level of expenditure.

A number of other limitations also influence the framing of the NIH budget. Certainly, large-scale expansion cannot be undertaken suddenly, because of the need for trained manpower and for space. The lead time necessary to produce a Ph.D. is between five and ten years after receipt of the baccalaureate degree, and lead time for the production of modern laboratory space averages about three years from the time of groundbreaking.

Exploitation of certain types of research opportunity is limited by cost in a somewhat special way. For instance, a definitive study of the effect of diet on the process of atherogenesis, though often considered, would be so expensive in funds, time and manpower that wisdom has always recommended deferral. In other cases the political climate may affect

judgments on the advisability of exploiting opportunities. For instance, research avowedly addressed to contraception was for all practical purposes unsupportable by the NIH before about 1962.

Budget Formulation

Each year, then, the NIH, in the light of its statutory missions, constructs a biomedical research budget, assessing present and emerging opportunities and recognizing inescapable limitations. Yet another limitation, arising in later stages of the process, is the ceiling imposed on NIH by the DHEW in accord with the latter's ceiling imposed by the President--or practically speaking, the OMB. The final recommendations of the NIH then reflect the agency's best judgment, in terms of scientific and social merit, as to the proper allocation of the resources that the President and the Department are willing to provide.

The budget for next year is one thing; a five-year budget projection is a considerably different matter. The discretionary funds actually available in a single year are small, as a result of the large amount of money that must be spent to sustain ongoing programs and to honor prior commitments. But estimates of such commitments become progressively softer for each future year. Moreover, the capability to foresee opportunities is severely circumscribed by the very nature of research. Thus inherent uncertainties tend to reduce long-range budget forecasts to an arithmetic exercise, with only a small fraction of the total reflecting predictable costs of current long-range commitments.

The Disposition of the NIH Budget Recommendations

The budget proposed by the NIH is reviewed within the Executive Branch by the DHEW and the OMB. Within the ceilings imposed, specific budgetary proposals must be acceptable to higher authority.

The focus of the DHEW review is in the broad context of health. The Department seeks assurance that the proposal, viewed in the light of submissions from other health agencies within the DHEW, reflects the most well-balanced and productive allocation of funds. Cognizance is taken of other Departmental goals--education, welfare--and addresses the question of optimal balance among all these missions.

The OMB review is also focused on intrinsic merit and balance. Its scrutiny, however, is in terms of the President's grand strategy, and its purview encompasses all health activities across the entire Federal scene. Beyond this, the OMB views the total national research budget and certain important subsets, such as the national budget for academic science. After extensive negotiations with the Federal agencies, involving all sorts and varieties of trade-offs, the OMB prepares the Executive Budget which the President transmits to the Congress. This document embodies the President's interpretation of his electoral mandate.

Next the budget proposed by the President undergoes lengthy and searching review by the appropriations committees and subcommittees in the House of Representatives and the Senate. It is defended by knowledgeable program operators, and a large number of nongovernmental witnesses are allowed to testify. The Congressional focus is principally on the social merit of the proposed expenditures, even though a serious effort is made

to obtain a balanced appraisal of the scientific status and promise of the fields under consideration.

The outcome of the Congressional review is strongly colored by the interests and commitments of the subcommittee chairmen and members, as well as by the scope of their responsibilities. For the last quarter of a century, the budgets proposed for the NIH have come before appropriations subcommittees deeply concerned with the Nation's health problems and convinced that research was vital to their solution. The recommendations of the subcommittees have usually fared well. Indeed, the Congress has frequently appropriated funds to the NIH in excess of those requested by the President. Increases include both specific earmarks for very narrow purposes and general increases in virtually all program areas.

Conclusion

In the light of the theoretical and practical considerations I have outlined, it is difficult to escape the conclusion that the issue posed is a matter of *process* rather than *ideology*. While there may be a series of rough guides that place approximate quantitative bounds on budget proposals, there are no operationally applicable principles that can be called normative. The ultimate decisions, the authoritative ones, are made through the political process by the political institutions of the Federal Government.

The NIH role in this process, as I have pointed out, is to formulate a set of recommendations. The final decisions require the NIH to execute the budget in the best interests of its missions and objectives: that is,

to support the best research efforts that can be found within the purposes for which the funds were appropriated; to sustain the system for research; and to seek maximum stability of the national biomedical research enterprise. If the higher levels of the Executive or the Congress desire a more or less intensive effort in a given field than was recommended by the NIH, the agency must, of course, accommodate.

The national interest would be well served--as would also be the individual and institutional performers of biomedical research--if the Executive Branch would at least accept some schedule of future funding as a target--one to be adhered to unless extraordinary events developed to force deviation. If the departmental five-year plan were to evolve in this direction, NIH planning of research and research facilities and manpower would be enormously facilitated. In advocating such a modus operandi, the NIH recognizes that the decision on funding level would be arbitrary. However, an arbitrary but certain target would be preferable to a flexible and uncertain one.

TAB 9

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Director's Advisory
Committee, 2/22/73

I. THE MISSION OF NIH

To advance health and well-being....

Pains have been taken to emphasize here that NIH does not pursue science for science's sake. There may be degrees of applicability in immediate goals, but ultimate improvement of health is our only purpose.

II. ORGANIZATION CHART

The present structure of NIH represents 4 broad phases:

1887 - 1937. Noncategorical laboratories.

1937 - 1968. Categorical institutes and divisions.

1968 - 1971. Reorganization to include BHME and NLM.

1971 - Promotion of NCI and NHLI to Bureaus.

More later on program development.

Now let's look at NIH in the context of national economic data and trends.

III. MEDICAL R & D AS A PROPORTION OF TOTAL HEALTH COST

National health cost rose from $12 billion in 1950 to $26 billion in 1960 (not shown) to $75 billion in 1971.

Medical R & D rose faster -- from 1% to 4%.

Latest figures for 1972 are $83 billion for total health, $3.5 billion for medical R&D -- still 4%.

IV. MEDICAL R & D AS A PROPORTION OF TOTAL R&D

Looking at total RAD, we again see abundant growth -- from $2.9 billion in 1950 to $13.7 billion in 1960 (not shown) to $29.2 billion in 1972 (not shown).

Medical R & D rose from less than 6% to 11% in 1971 and 1972 -- $3.3 billion last year.

Federal Government is the largest source of medical R&D funds (insert) -- 63%; while academic labs are the largest performer -- 35%. (The latter figure went to 36% last year.)

V. FUNDS FOR MEDICAL R & D BY SOURCE

Federal and non-Federal sources contributed about equally in the early 1950s.

After 1957 the Federal portion rose faster than the non-Federal to reach the present ratio of 2 to 1.

	1972 Actual	1973 est.
Federal	$2.129 billion	$2.219 billion

VI. NIH FUNDS AS A PROPORTION OF NATION'S MEDICAL R & D

NIH contributed $1.267 billion to R & D in FY 1972. This is expected to go to $1.315 in 1973 — representing a drop from 59.5% of the Federal to 59%. (Based on the President's Budget as revised 1/15/73.)

To summarize from these and other data: NIH accounts for 8% of all Federal R & D, 90% of Federal support of R & D at educational institutions, 37% of Federal support of academic science.

VII. NIH OBLIGATED FUNDS BY FUNCTION, FY 1956-1972

A look at NIH by activity over time.

Oldest function: research — first direct, then regular grants, then special grants. Totaled 57% in 1972.

Research training, construction.

Biomedical communications, education programs.

The 1972 estimate was accurate. The comparable bar for FY 1973 would total $2.2 billion.

VIII. TYPICAL INSTITUTE OF NIH

Returning to organization, let's look at the structure of a hypothetical typical Institute.

Intramural research — laboratory and clinical.

Collaborative studies — mostly research contracts.

Extramural programs — common to all Institutes and DRR.

DRG, FIC, DRS, DCRT, CC serve all the Institutes.

IX. OCCUPATIONAL AND FUNCTIONAL DISTRIBUTION OF NIH PERSONNEL

Another way to look at structure — at least in the aggregate -- is to view personnel.

12,000 scientists and supporting workers

Includes 2,200 professionals with doctoral degrees of which about half are M.D.s, about 42 percent Ph.D.s, and the rest D.D.S., D.V.M., and other.

[Ad lib to fill time]

X. 1974 PRESIDENT'S BUDGET (BY PROGRAM)

The good view of current and prospective programs is afforded by the 1974 President's Budget.

1/RDs by Institute and Research Division.
Note the change column — the increase in Cancer of $73.9 million (appropriations), or $73.6 in obligations — 1974 over 1973. Heart — $17.9 million increase.

GMS and research resources, notably, but also other Institutes will decrease accordingly.

Manpower and the Library will also decrease.

XI. 1974 PRESIDENT'S BUDGET (BY ACTIVITY)

The overall effect of these changes on regular grant programs would be a net decrease of $4 million.

Special grants programs are up $18 million — largely due to increase in specialized research centers.

Fellowships are down $6 million, training grants $17.

Direct operations rise $56 million, principally by increases in the R & D contract programs.

Again the overall effect on I/RD obligations is a net increase of $48 million.

#737

NOTE.—DO NOT USE THIS ROUTE SLIP TO SHOW FORMAL CLEARANCES OR APPROV

DATE 7/17/73

TO:

~~Mr. Carrigan~~

Please file -

Speeches

AGENCY BLDG. ROOM

1/201

☐ APPROVAL ☐ REVIEW ☐ PER CONVERSATION

☐ SIGNATURE ☐ NOTE AND SEE ME ☐ AS REQUESTED

☐ COMMENT ☐ NOTE AND RETURN ☒ NECESSARY ACTION

☐ FOR YOUR INFORMATION

☐ PREPARE REPLY FOR SIGNATURE OF

REMARKS:

Note: August 6 Deadline

Should we try Clinical Research, Robt. J. Levine, ed.? No. Dr. Kennedy says to forget it.

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To

From Planning & Evaluation, NIH

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ASSOCIATION OF AMERICAN MEDICAL COLLEGES
SUITE 200, ONE DUPONT CIRCLE, N.W., WASHINGTON, D.C. 20036

JOURNAL OF MEDICAL EDUCATION
WASHINGTON: 202: 466-5

July 10, 1973

Thomas J. Kennedy, Jr., M.D.
Associate Director for Program
Planning & Evaluation
National Institutes of Health
Department of Health, Education,
and Welfare
Bethesda, Maryland 20014

Dear Dr. Kennedy:

The members of our Editorial Board who reviewed your Manuscript, "NIH Research Program-Project and Center Grants," did not recommend it be accepted for publication in the Journal of Medical Education in its present form. However, we will be delighted to consider it for publication as a Communications if you would condense the paper to not more than four double-spaced typed pages and limit the article to one table or figure.

The reviewers, of course, feel that the subject of your manuscript is of urgent interest to medical educators. However, they do not think the full article should be published since the figures are old (and would be older before we could get the paper into print), are familiar in general to most of our readers, and are available elsewhere. They also feel there is some redundancy and irrelevance in the data and that the last page of questions adds little to the paper.

If you wish to have your manuscript reconsidered, please send us your revision by August 6. We look forward to hearing from you.

Sincerely,

Merrill T. McCord

Merrill T. McCord
Editor

MTM:dh

NIH RESEARCH PROGRAM-PROJECT
AND CENTER GRANTS*

Thomas J. Kennedy, Jr., M.D.; Ann A. Kaufman, Ph.D.;
John C. James, Ph.D.; and Solomon Eskenazi**

An examination of the impact of research program-project and center grants upon academic health centers might well begin with an attempt to characterize the awards of this genre made by the National Institutes of Health, their principal source, and to review historical events anteceding the present situation.

The Current Scene

Tabulated in the first figure are four sets of frequency distributions by size of award. The first two columns show the distribution of NIH *research project grants*. The NIH has always attached tremendous significance to the grants in this category, which support the projects originated by investigators throughout the country, deemed by the NIH to be related to the mission of one of its institutes, reviewed objectively under the impartial auspices of the Division of Research Grants for scientific merit, and assigned a program priority by the

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*Presented by Dr. Kennedy before the American Association of Medical Colleges, Washington, D.C., 3/29/73.

**Associate Director for Program Planning and Evaluation, National Institutes of Health, U.S. Dept. of Health, Education, and Welfare; Research Grants Officer, Office of the Associate Director for Extramural Research and Training, NIH; Chief, Research Analysis and Evaluation Branch, Division of Research Grants, NIH; and Chief, Statistics and Analysis Branch, DRG, NIH.

National Advisory Council of the institute responsible for support of the application. These grants are the heart of fundamental biomedical research in this country, the fountainhead of scientific knowledge constituting the foundations upon which future progress depends. They tend to be small: 68 percent are below $50,000 and 95 percent below $100,000. About half of them, accounting for almost 40 percent of the dollars in this category, are funded at an annual level of $25,000 to $50,000. The situation is quite different for the other three types of award shown in the table.

Research program project grants are larger, with about 90 percent in excess of $100,000. Seventy-seven percent are funded at levels of $100,000 to $500,000 and account for 60 percent of the funds. About 10 percent exceed $0.5 million, with a few in excess of $1 million. Small program project grants--under $100,000--accounted for only 2 percent of the program project funds in fiscal year 1972.

The *general clinical research centers* cluster between $300,000 and $700,000. The interval encompasses 75 percent of the grants and 67 percent of the funds.

The other grants in this class, labeled for brevity as *research centers*, include a fairly wide variety of large and small operations distributed rather evenly over the whole range. The 84 grants under $100,000--roughly one-third of the universe--include many that support animal resources.

In terms of distribution by award size, the grants in the last three sets of columns are clearly different from the traditional research

project grants. They constitute the universe to be discussed henceforth.

Figure 2 depicts the major classes of programs in this universe. The bars are proportional in length to the funding level in 1972, and the numbers at the left show the number of grants. There is a slight difference between the values shown in the chart and those in the previous figure (1) because of differences in the treatment of supplemental awards,* but the discrepancies are insignificant for purposes of discussion. Research program projects are the largest single component, accounting for about 54 percent of the funds and 58 percent of the awards in the group. Ten species of center and other special grants are enumerated, including the first recognized--general clinical research centers--as well as the most recently created--sickle-cell anemia centers.

The NIH has always been a highly decentralized organization, characterized by minimal central control and by delegation of much authority and discretion to its component institutes. As a result, within broad policy guidelines, wide variability in practice as between institutes has evolved. Generalizations about NIH *programs* are dangerous, and it is necessary to look at each institute in order to fully grasp current realities.

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*So as not to distort the frequency distribution, supplements to previous years' grants are excluded.

The next figure (3) shows the number and dollar-value of program-project and center awards funded by each of the institutes. Several institutes do not subdivide their program projects, while some identify specific subgroups.

Center grants tend to have a strong clinical flavor, as in the case of the categorical clinical centers of the National Institute of Arthritis, Metabolism and Digestive Diseases, or reflect a sub-mission of an institute's overall goal, as in the allergic disease centers and transplantation/immunology centers of the National Institute of Allergy and Infectious Diseases.

Both the National Institute of General Medical Sciences and the National Institute of Child Health and Human Development tend to utilize program projects and centers for supporting research in their major domains of concern. For NIGMS, awards of both types support pharmacology/toxicology, genetics, anesthesiology, and diagnostic radiology. Trauma research has large clinical components--hence the centers--while the problems under attack in research on automated clinical laboratories, on the cellular basis of disease, on biomedical engineering, and on adaptation and behavior have a preponderantly laboratory flavor. NICHD sponsors activities in growth and development, perinatal biology/infant mortality, cell aging, population research, and mental retardation. The last two are supported under both types of award.

The same patterns characterize the programs of the National Heart and Lung Institute and the National Institute of Neurological Diseases and Stroke, with the latter institute providing the greatest variety.

The largest investor in centers, both in dollars and awards, is the Division of Research Resources, formerly the Division of Research Facilities and Resources (and earlier still, a component of NIGMS). These programs, wherever organizationally located, were the first centers on the scene, and embody one very important element of many large grants: a central core of resources--equipment such as beds or computers or primates, and special types of personnel such as dieticians, computer programmers, primatologists, or metabolic unit nurses--for a broad program of research.

This, then, was the scene in August 1972. The NIH was funding 807 program projects and centers for $290 million, through all of its institutes and research divisions, under a wide variety of names and types. Over the fiscal year 1972, as shown in Figure 1, the NIH awarded 825 of these special grants for $293 million.

History

Historically, how did we get here? In the late 1950s two inadequacies in the machinery for the Federal support of biomedical research surfaced. The first of these related to and, we suspect, was precipated by the emerging strength and increased capability created by a decade and a half of exuberant growth. The need to coordinate and integrate related research within many grantee institutions became apparent. Particularly important from the point of view of the institution was the need or desirability to pool equipment, to share facilities and resources, to utilize more fully technical and supportive personnel, and finally, to bring an end to the bookkeeping nightmare

of prorating the cost of animal facilities, technical aides, secretaries, equipment, and supplies against multiple grants when, *de facto,* they were used commonly by a group of principal investigators on several research projects.

From the NIH point of view, the thematic interrelationship of many projects within a grantee institution to the mission of the funding National Institute, and the presence--usually--of one or two scientists in acknowledged leadership roles, emphasized that this group of projects really constituted a coherent program with structured scientific and intellectual leadership, rather than a simple collection of random research projects in a single locus. Accordingly, the NIH was on the verge of coining the term "program grant" to support such ventures when the Office of the General Counsel reminded us--in forceful and official terms--that our authority was limited to the award of *project grants.* The ensuing lengthy discussion of the word "project" eventuated in a compromise--the somewhat awkward semantic tag "program project."

The other inadequacy in the armamentarium of NIH support mechanisms emerged from the difficulties experienced by clinical investigators in either financing metabolic units or in conducting metabolic balance studies outside such units. This led to requests that the NIH provide these units with basic logistical support, to a parallel advocacy before congressional appropriations committees, and to the eventual creation by the Congress of the General Clinical Research Center Program, together with a good legislative history for categorical clinical research centers. The erstwhile Director of the NIH, Dr. James A. Shannon, fought with his usual resourcefulness to keep all of the

clinical research in an institution limited to and focused in one discrete locus and supported through one single instrument. He feared that otherwise, there would be an endless proliferation and fragmentation, with high and unnecessary overhead costs and serious organizational strains in the grantee institution. He was opposed by articulate spokesmen from the scientific research community who emphasized the need for categorical visibility--i.e., heart disease, cancer--to ensure continued public recognition of the importance of the problem and to guarantee sustained support. As is clear from the previous figure, Shannon didn't win all the battles he engaged in.

Without going too far back into history, let us review the fiscal evolution of the programs since 1967, in the context of the total NIH research program and in both absolute and relative terms.

Figure 4 illustrates that NIH extramural research awards *in toto* grew from $685 million to $1,045 million. Fiscal 1972 was a somewhat exceptional year as a result of the marked expansion of the cancer program and the somewhat more modest but still exceptional increase for the National Heart and Lung Institute. Over this period general research support grants remained about constant, as did research project grants until last year. On the other hand, there was a parallel and steady growth, accentuated in 1972, of both program projects and centers. The latter, funded at $154 million in 1967, rose to the $296 million level.

Figure 5 depicts this growth in terms of the proportion of NIH research support attributable to the several types of award. Program

project and center grants increased from 22.5 percent to 28.3 percent of all NIH extramural research support--a growth exceeded only by that of research contracts, which almost doubled. The research project grants now represent a decidely smaller fraction of NIH support than they did in 1967.

Figure 6 tabulates the change in numbers of competing new and renewal awards since fiscal 1967, with the level for that year normalized to 100. The number of research project awards fell in 1968 and remained down until fiscal 1972, when it rose appreciably, approaching the 1967 level. By contrast, the number of program projects and centers rose significantly over the period. Renewals increased almost threefold.

Comparison of applications received by the NIH for new and renewal research grants reveals a similar pattern (Figure 7). After fiscal year 1967, the total of competing applications dropped; then those for research project grants rose in 1972 to 110 percent of the 1967 level, as compared with 216 percent for the program project and center grants.

Nature of the Beast

As one reviews the various documents discussing the conception, gestation, birth, and development of the activities supported under the title of program-project or center grants, there is little to gratify the theoretician's appetite for a rationale. Among the properties that were ascribed to the research characterized as ideally suited for support through these instruments were its multidisciplinary nature, its thematic or programmatic coherence, its unusually wide scope, its probable long-term course, and its need for stable logistical support.

What are the actual characteristics of the instruments at present? Recently, the Executive Committee on Extramural Affairs, NIH, chaired by Dr. Thomas E. Malone, surveyed the institutes to illuminate this question.

Figure 8 reflects a bureaucratic concern, indicating which of the center grant programs warrant specific line items in the budgets of the several institutes. Six institutes reflect these programs in a total of nine budget line items. This information may interest those of you who are dedicated watchers of the annual budget documents.

The data in figure 9 reflect some other characteristics of this universe of awards. In contrast to research project grants, of which the Division of Research Grants is responsible for most of the initial review, program project and centers grants are often, though not always, reviewed within the awarding institute. Moreover, they are subject to more frequent surveillance and more careful monitoring than research project grants, which typically are reviewed only at the end of the project period.

Figure 10 displays the wide variation in practice between institutes--and actually within single institutes--with respect to the activities for which funds may legitimately be spent. For example, "core" support--the basic personnel, facilities, and resources--is prohibited in some awards, allowed in others, encouraged in many, and required in a few.

Funds for support of discrete research projects in addition to core support may likewise be prohibited, permitted, encouraged, or required under the specific terms and conditions of awards from various institutes or their components. Similar variability characterizes

attitudes and policies under grants of this genre regarding the support of administrative or research staff, facility renovation, clinical beds, research or clinical training, and fees for service and subcontracts.

Thus the program project and center grants appear to be quite heterogeneous in character, and in many cases the distinction between them is hard to discern, even within a single institute.

There are certain properties, however, that emerge from analyses of DRG data which sharply differentiate awards of this type from research project grants, and may constitute grist for an issue as yet inchoately articulated.

The next two figures (11 and 12) show, at two points in time, the distribution of support by age of grant for traditional research projects and for program projects and centers. Concentrating first on the right side--traditional research grants--there is an almost exponential decline in funds as projects age. In fiscal year 1967 $68 million was in projects in their first year, $49 million in projects in their second year, $39 million in projects in their third year, etc., with only a small fraction in projects older than 10 years. No such attrition with aging is apparent for the special grants, with an almost equivalent amount in projects of all ages. Viewed 4 years later, in fiscal year 1971, the same general pattern prevails.

These data are open to a variety of interpretations, but some would seem incontestable. Most research project grants terminate after a relatively brief time, and few extend beyond one or two rounds of renewal competition. Investigators wind up their projects in due

course and initiate entirely new ones; only rare ones continue to be productive and worthy of continued funding for extended periods. Program projects and centers, on the other hand, do not experience this pattern of attrition, at least over the period of examination. This observation suggests that within the broad boundaries of the grant, internal adjustments to purge the nonproductive, to expand the productive, and to create new ventures are possible. Thus, the programs continue to be relevant in a timely way to the concerns and goals of the funding national institute and to warrant continued support.

Figure 13, in a sense, is another expression of the phenomenon just illustrated. The graphs compare the award rates--that is, the fraction of these grant applications approved by National Advisory Councils which are actually awarded--for research project grants and for program project and center grants. For both genres the renewal applications fare better than the new ones, with renewal program project and center grants, especially the largest ones, doing extraordinarily well. Whether the application be new or renewal, the award rates are almost always higher for the program project and center grants than for the research project grants.

With respect to the dollars awarded (Figure 14), it is once again evident that a higher fraction of the approved dollars are awarded in program project and center grants than in research project grants. For example, in fiscal year 1972, about 80 percent of the approved dollars for the program projects and centers were awarded, while only 65 percent of the research-project grant dollars were made available.

These data suggest that the special grants fare better in competition than the project grants. If so, why? and what does this condition imply for the grantee institution?

Discussion

Program project and center grants probably fare better because they approximate more closely the missions of the institutes as perceived by the officials in those organizations, and are more likely to yield information meeting requirements for immediate, applicable results. Since these grants are large, the development of grant applications is a long and painstaking process, undertaken often under Federal stimulation, directed toward preselected institutions recognized as sites of unusual capability, and almost always in consultation and negotiation with the Federal agency. Initial scientific review is associated with, rather than divorced from, the awarding institute, and the National Advisory Council of the institute has often played an important role in stimulating the development of the program of which the application is, or is about to be, a component.

From the NIH viewpoint, then, the program-project and center grants are available instruments with which to tackle a specific categorical mission, and hence should fare well in the competition for funds. The NIH also recognizes the role played by the academic institutions themselves as performers of biomedical research and as developers of research manpower, and is well aware that the viability and strength of these institutions is essential for a high-quality national research enterprise. From the Federal perspective, the relative stability of the special grants, combined with their capacity to support a substantial

fraction of the salaries of a significant number of faculty members, is viewed as a contribution to the stabilization and strengthening of the institutional framework.

As to perceptions from the performer institution's side, there are many at this conference better qualified than we to offer facts and interpretations. We will limit our remarks to questions that seem, *a priori* and theoretically, to encompass matters of legitimate concern.

Do problems arise in an academic institution from the requirement imposed by large grants to match programs and goals so closely to those of a Federal agency?

Is the institution's governance over its grantee components compromised?

Is undue Federal interference in the destiny of the university introduced through the siren song of large dollar awards?

Is the gain in stable support worth the trade-off, if such there is, in academic autonomy and independence?

Is the stability real or apparent? Does the university have to go through less angst, sturm and drang, etc., to ratify the reprogramming of activities and the replacement of personnel so necessary to guarantee the stability of the special grant than it would in adjusting to the ebb and flow of regular research grant funds?

Can an academic institution become saddled with an activity that, however grand for the Federal Government and for national goals, is out of line with its own current aims, objectives, and aspirations?

These are some of the questions that arise in any consideration of the impact of program projects and centers, particularly in regards to their competition with traditional research project support.

FIGURE

NIH RESEARCH GRANTS BY DOLL...-AWARD INTERVAL, FY 1972*
(DOLLARS IN MILLIONS)

DOLLAR AWARD INTERVALS (IN THOUSANDS)	RESEARCH PROJECTS		RESEARCH PROGRAM PROJECTS		GEN. CLIN. RESEARCH CENTERS		OTHER RESEARCH CENTERS	
	NUMBER	AMOUNT	NUMBER	AMOUNT	NUMBER	AMOUNT	NUMBER	AMOUNT
TOTAL	9562	$448.3	477	$156.9	83	$42.1	265	$94.0
$0 - 25	1977	35.4	2	.0	-	-	12	.1
$25 - 50	4510	164.5	5	.2	-	-	22	.9
$50 - 75	1932	116.5	21	1.4	-	-	27	1.7
$75 - 100	653	55.8	22	1.9	-	-	23	2.0
$100 - 150	338	39.9	68	8.4	1	.1	27	3.4
$150 - 200	75	12.8	68	12.0	-	-	21	3.6
$200 - 250	42	9.2	44	9.7	2	.5	10	2.3
$250 - 300	15	4.2	52	14.3	4	1.1	10	2.7
$300 - 350	3	1.0	45	14.4	10	3.3	15	4.9
$350 - 400	7	2.6	40	15.0	11	4.0	17	6.4
$400 - 450	2	.8	24	10.2	11	4.7	9	3.8
$450 - 500	-	-	24	11.4	10	4.7	13	6.1
$500 - 550	2	1.0	10	5.2	5	2.6	5	2.6
$550 - 600	-	-	6	3.5	6	3.4	7	4.0
$600 - 650	3	1.9	11	6.9	5	3.0	4	2.5
$650 - 700	-	-	3	2.0	4	2.7	5	3.4
$700 - 750	1	.7	4	2.9	2	1.4	6	4.3
$750 - 800	1	.8	3	2.3	2	1.5	3	2.3
$800 - 850	-	-	5	4.1	5	4.2	6	4.9
$850 - 900	-	-	3	2.6	1	.9	-	-
$900 - 950	-	-	4	3.7	1	.9	3	2.8
$950 - 1000	-	-	-	-	2	2.0	1	1.0
$1000 - 7000	1	1.1	13	24.6	1	1.0	19	28.2

* ... include supplements to previous years' awards.

Figure 2

NIH RESEARCH PROGRAM-PROJECT AND CENTER GRANTS, BY TYPE OF GRANT, FY 1972*

*SUPPLEMENTS ARE NOT COUNTED IN NUMBERS OF GRANTS EXCEPT THOSE MADE FOR A PREVIOUS YEAR'S AWARD. AMOUNTS INCLUDE ALL SUPPLEMENTS.

Figure 3
NIH Research Program Projects and Centers as of August 1972
(Dollars in Millions)

Institute	Type of grant	Number	Amount
Allergy	Program projects	7	$ 2.4
	Allergic disease centers	9	.6
	Transplantation/immunology centers	3	.6
			$ 3.6
Arthritis	Program projects	37	8.4
	Categorical clinical centers	10	2.2
			$ 10.6
Cancer	Clinical research centers	57	28.9
	Preclinical research centers	26	19.7
	Exploratory studies for centers	42	4.2
			$ 52.8
Dental	Program projects	19	4.7
	Categorical clinical research center	1	.4
	Dental research institutes	5	6.5
			$ 11.6
Eye	Program projects	10	3.3
	Research centers	2	.3
	Outpatient research centers	11	.7
			$ 4.3
Environmental Health	Program projects	12	3.7
	University-based centers	6	3.9
			$ 7.6

(Continued)

NIH RESEARCH PROGRAM PROJECTS AND CENTERS AS OF AUGUST 1972 (DOLLARS IN MILLIONS) (CONT.)

INSTITUTE	TYPE OF GRANT	NUMBER	AMOUNT
GENERAL MEDICAL SCIENCES	PHARMACOLOGY/TOXICOLOGY P.P.	9	$ 2.0
	GENETICS & GENETIC CHEM. P.P.	14	5.9
	ANESTHESIOLOGY P.P.	2	.9
	DIAGNOSTIC RADIOLOGY P.P.	3	1.2
	AUTOMATED CLINICAL LABS P.P.	5	1.7
	CELLULAR BASIS OF DIS. P.P.	8	2.2
	BIOMEDICAL ENGINEERING P.P.	11	4.0
	ADAPTATION & BEHAVIOR P.P.	2	.7
	PHARMACOLOGY/TOXICOLOGY CENTERS	12	6.4
	GENETICS CENTERS	7	4.6
	ANESTHESIOLOGY CENTERS	4	3.2
	DIAGNOSTIC RADIOLOGY CENTERS	2	1.1
	TRAUMA CENTERS	8	2.4
			$ 36.3
CHILD HEALTH	POPULATION RESEARCH PROGRAM PROJECTS	9	2.0
	GROWTH AND DEVELOPMENT P.P.	11	2.2
	MENTAL RETARDATION PROGRAM PROJECTS	21	6.1
	PERINATAL BIO/INFANT MORTALITY P.P.	8	1.9
	CELL AGING PROGRAM PROJECTS	3	.7
	POPULATION RESEARCH CENTERS	5	1.3
	MENTAL RETARDATION CENTERS	12	5.6
			$ 19.8

(CONTINUED)

NIH RESEARCH PROGRAM PROJECTS AND CENTERS
AS OF AUGUST 1972 (DOLLARS IN MILLIONS) (CONT.)

INSTITUTE	TYPE OF GRANT	NUMBER	AM
HEART	PROGRAM PROJECTS	76	$
	SCOR--ARTERIOSCLEROSIS CENTERS	15	
	SCOR--HYPERTENSION CENTERS	5	
	SCOR--PULMONARY DISEASE CENTERS	17	
	SCOR--THROMBOSIS CENTERS	5	
	COMPREHENSIVE SICKLE CELL CENTERS	10	
			$
NEUROLOGY	GEN. NEURO. DISORDERS P.P.	8	
	CHRONIC NEURO. DISORDERS P.P.	1	
	SENSORY AND PERCEPTUAL DISORDERS	7	
	DISORDERS OF HEARING P.P.	5	
	NERVE INJURY AND REGENERATION P.P.	2	
	GEN. NEURO. DISORDERS CENTERS	2	
	CEREBROVASCULAR DISORDERS CENTERS	15	
	HEAD INJURY CLIN. RESEARCH CENTERS	5	
	ACUTE SP. CHORD INJURY CLIN. RES. CTRS.	6	
	CONVULSIVE DISORDERS CLIN. RES. CTRS.	3	
	SENSORY, PERCEPTUAL DISORDERS CL. R. CTRS.	3	
	CHRONIC NEURO. DISORDERS CL. R. CTRS.	3	
	DISORDERS OF HEARING CLIN. RES. CTRS.	1	
	OUTPATIENT CLIN. RES. CENTERS	4	
	MUSCULAR AND NEUROM. CLIN. RES. CTRS.	3	
			$

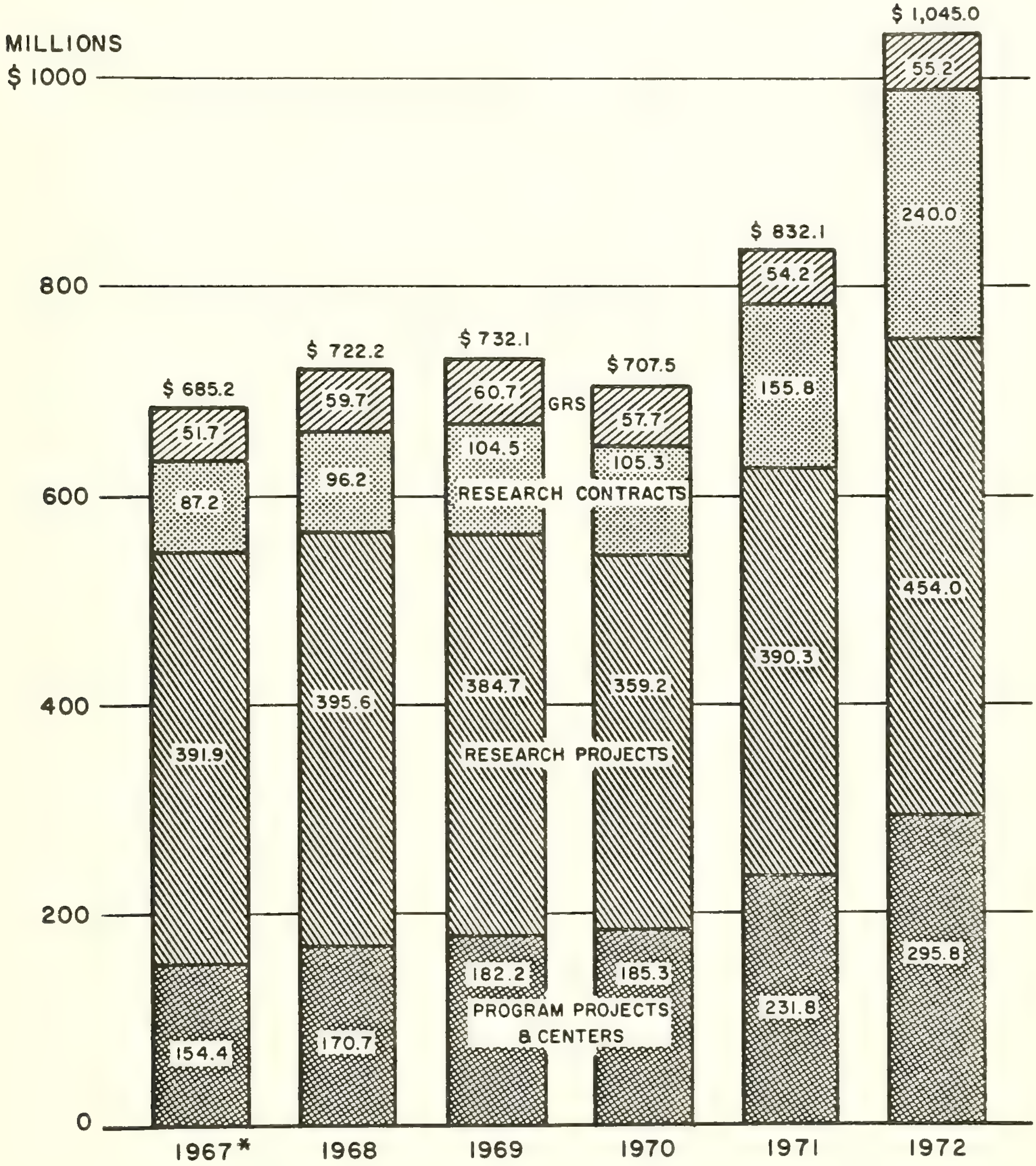
(CONT.

. NIH RESEARCH PROGRAM PROJECTS AND CENTERS AS OF AUGUST 1972 (DOLLARS IN MILLIONS) (CONT.)

INSTITUTE	TYPE OF GRANT	NUMBER	AMOUNT
RESEARCH RESOURCES	BIOTECHNOLOGY RESOURCE CENTERS	40	$ 10.4
	PRIMATE RESEARCH CENTERS	7	11.2
	ANIMAL COLONIES, ANIMAL MODEL DEV.	29	2.1
	ANIMAL RESOURCE DIAGNOSTIC LABS.	16	1.1
	INST. ANIMAL RESOURCE IMPROVEMENT	23	2.1
	GENERAL CLINICAL RESEARCH CENTERS	83	42.2
			$ 69.1

Figure 4

FUNDS AWARDED FOR NIH RESEARCH GRANT AND CONTRACT PROGRAMS, BY TYPE OF PROGRAM, FY 1967-1972

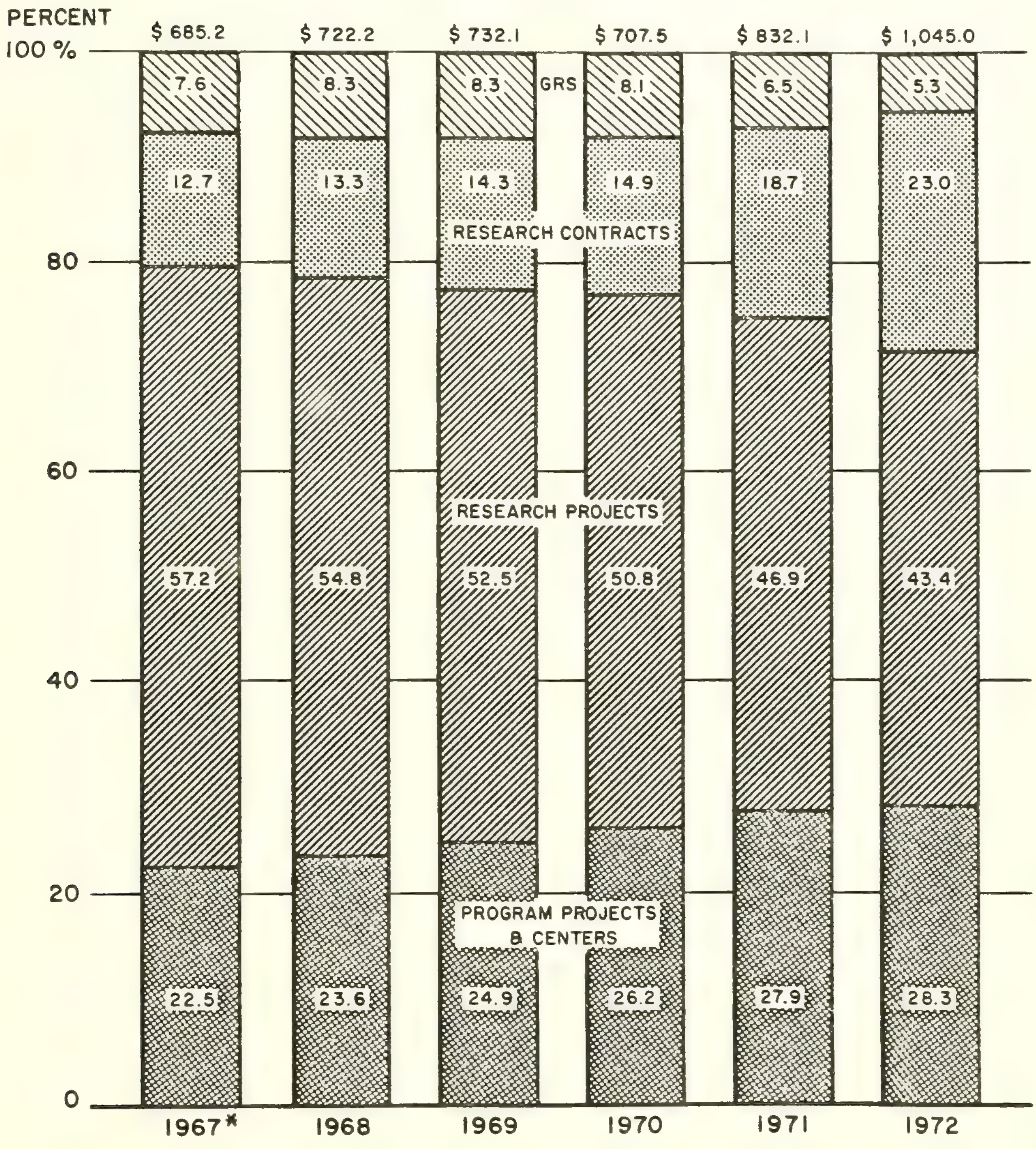


* BHME AND NLM ARE INCLUDED FOR COMPARABILITY, THOUGH NOT CONSTITUENTS OF NIH UNTIL APRIL 1968.

Figure 5

PERCENTAGE DISTRIBUTION OF FUNDS AWARDED FOR NIH RESEARCH GRANT AND CONTRACT PROGRAMS, BY TYPE OF PROGRAM, FY 1967-1972

(DOLLARS IN MILLIONS)



* BHME AND NLM ARE INCLUDED FOR COMPARABILITY, THOUGH NOT CONSTITUENTS OF NIH UNTIL APRIL 1968.

FIGURE 6—NUMBER OF COMPETING NIH GRANTS FOR REGULAR RESEARCH PROJECTS AND PROGRAM-PROJECTS AND CENTERS, FY 1967-1972*

Type of Grant	1967	1968	1969	1970	1971	1972
Research Projects	100 N=3,927	76.8	82.8	64.2	67.9	90.8
New	100 N=2,210	67.6	77.4	52.5	64.2	91.9
Renewals	100 N=1,717	88.6	89.7	79.3	72.7	89.3
Program Projects & Centers	100 N=141	105.7	139.7	116.3	148.2	197.9
New	100 N=99	81.8	90.0	47.5	106.1	162.6
Renewals	100 N=42	157.1	257.1	278.6	247.6	281.0

*Excludes supplemental and continuation awards.

FIGURE 7

COMPETING NEW AND RENEWAL APPLICATIONS FOR NIH RESEARCH-PROJECT AND PROGRAM-PROJECT AND CENTER GRANTS, FY 1967-1972

TYPE OF GRANT	1967	1968	1969	1970	1971	1972
RESEARCH PROJECTS	100 N = 8,084	93.3	95.1	95.5	96.5	109.6
PROGRAM PROJECTS & CENTERS	100 N = 233	101.3	127.5	111.2	148.1	216.3

FIGURE 8

CENTER GRANT PROGRAMS WITH BUDGET "LINES"

- <u>NCI</u> CLINICAL + PRECLINICAL + EXPLORATORY = 1 (P02 + P01)
- <u>NHLI</u> SCOR (P17) = 1
- <u>NICHD</u> MENTAL RETARDATION CENTERS = 1
- <u>NIDR</u> CENTERS (P02) + INSTITUTES (P13) = 2
- <u>NIEHS</u> CENTERS (P10) = 1
- <u>NIGMS</u> CENTERS: PHARM-TOX (P11), ANESTH. (P01), RADIOL. (P01) = 3

Figure 9

SCIENTIFIC REVIEW OF PROGRAM-PROJECT AND CENTER GRANTS, 1972

Responsibility for initial scientific review	
Div. of Res. Grants	14
Awarding Institute	31
Frequency of scientific review	
Annually (interim review)	40
Biennially (interim review)	1
For continuation awards only—	38
At end of third year	11
At end of fourth year	27

FIGURE 10

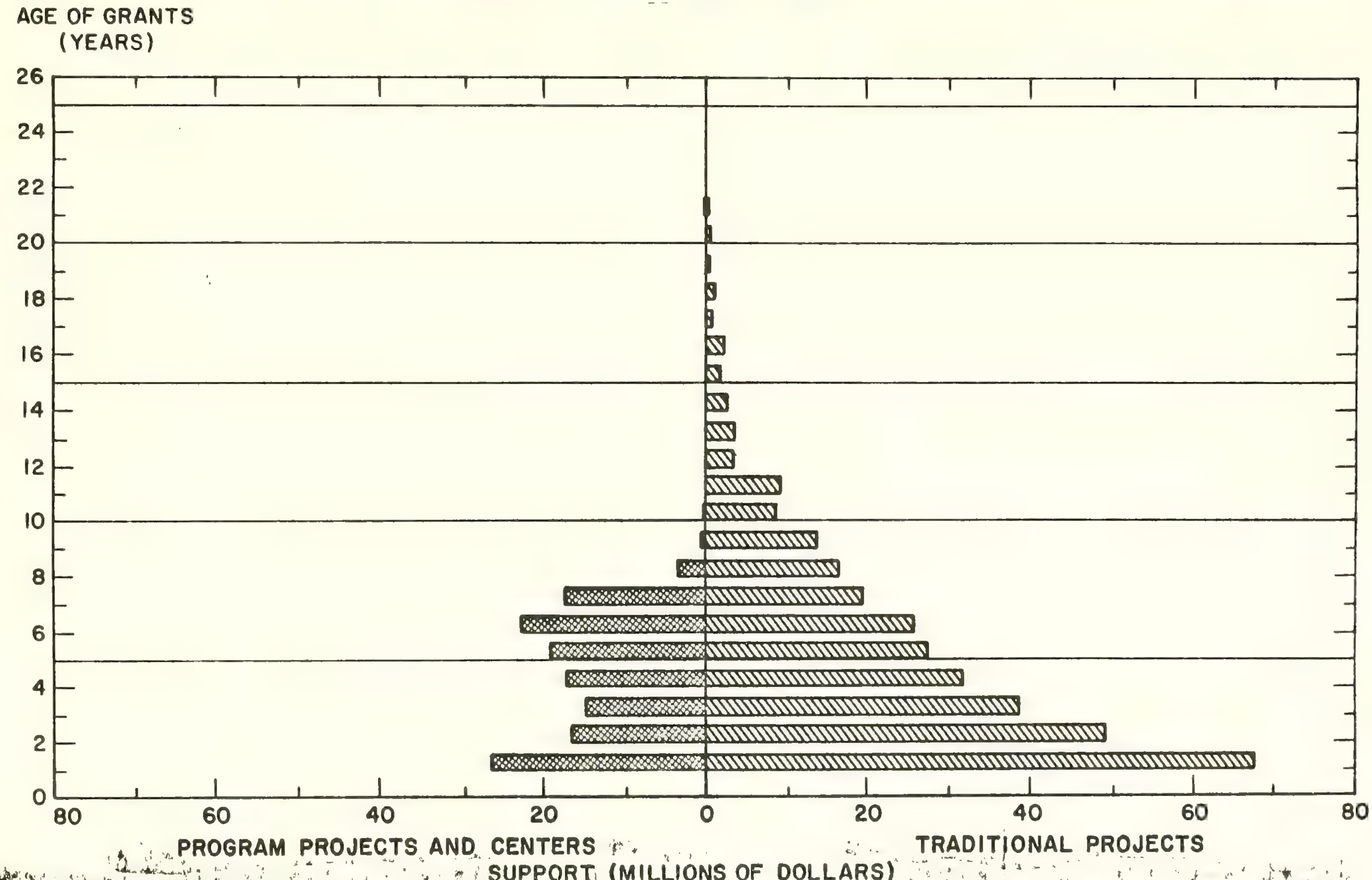
ALLOWABLE SUPPORT UNDER
NIH PROGRAM-PROJECT AND CENTER GRANTS, 1972

$ FOR—	NOT ALLOWED	ALLOWED	ENCOURAGED	REQUIRED
CORE*	5	20	15	5
PROJECTS	5	14	5	17
ADMIN. STAFF	-	30	8	3
RESEARCH STAFF	3	12	8	21
SPACE	4	19	7	4
BEDS	9	30	2	3
RES. TRAINING	40	-	4	-
CLIN. TRAINING	40	-	2	-
FEES + SUBCONTRACTS	9	34	1	-

*NO PROGRAM-PROJECT GRANTS.

Figure 11

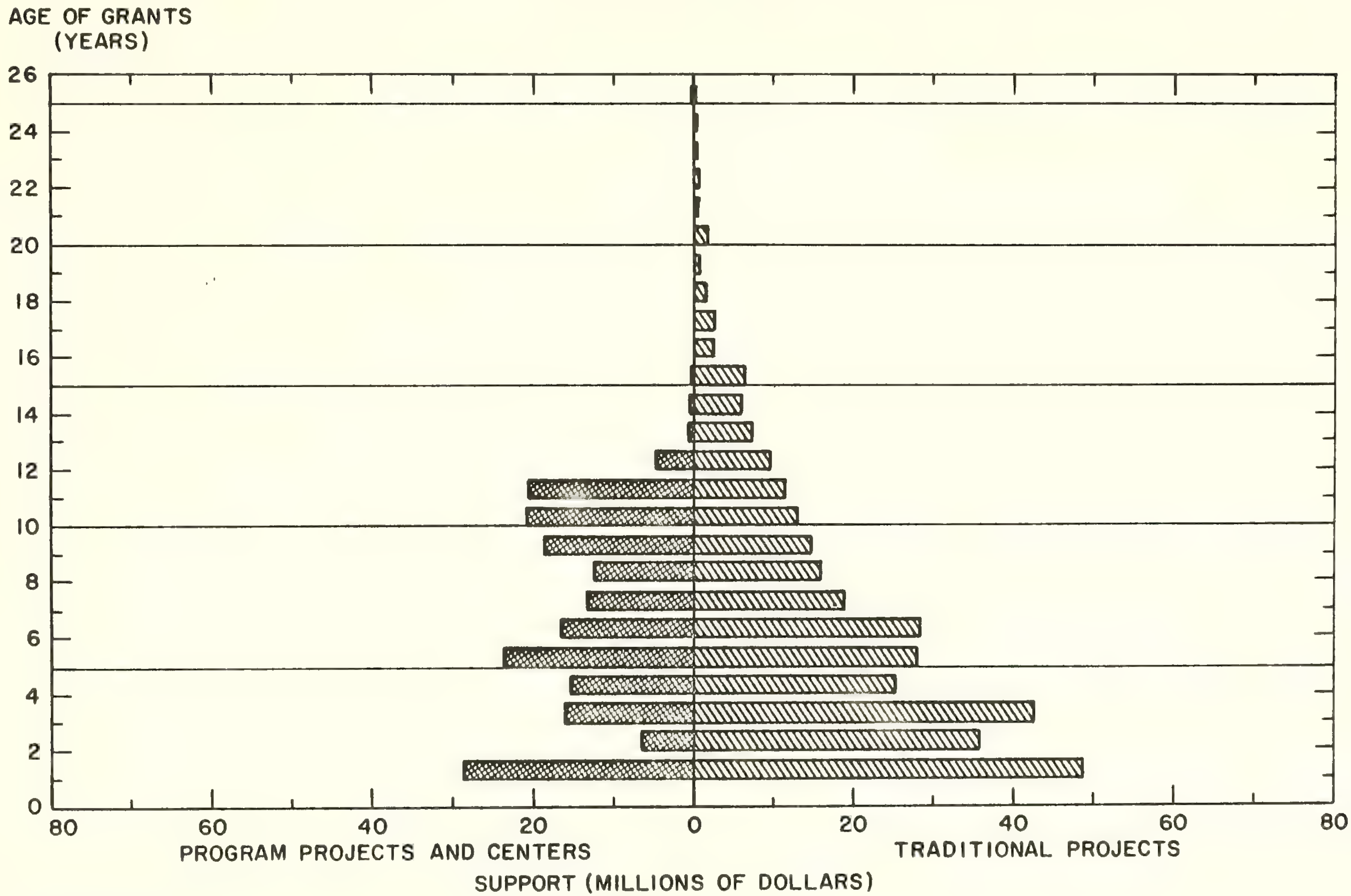
DISTRIBUTION OF NIH RESEARCH GRANT FUNDS BY PROGRAM AND AGE OF GRANT, FISCAL YEAR 1967*



* EXCLUDING NCI

Figure 12

DISTRIBUTION OF NIH RESEARCH GRANT FUNDS BY PROGRAM AND AGE OF GRANT, FISCAL YEAR 1971*



*EXCLUDING NCI

Figure 13

AWARD RATES OF NIH NEW AND RENEWAL GRANTS FOR RESEARCH PROJECTS AND PROGRAM-PROJECTS AND CENTERS, BY DOLLAR-AWARD INTERVALS, FY 1967-1972

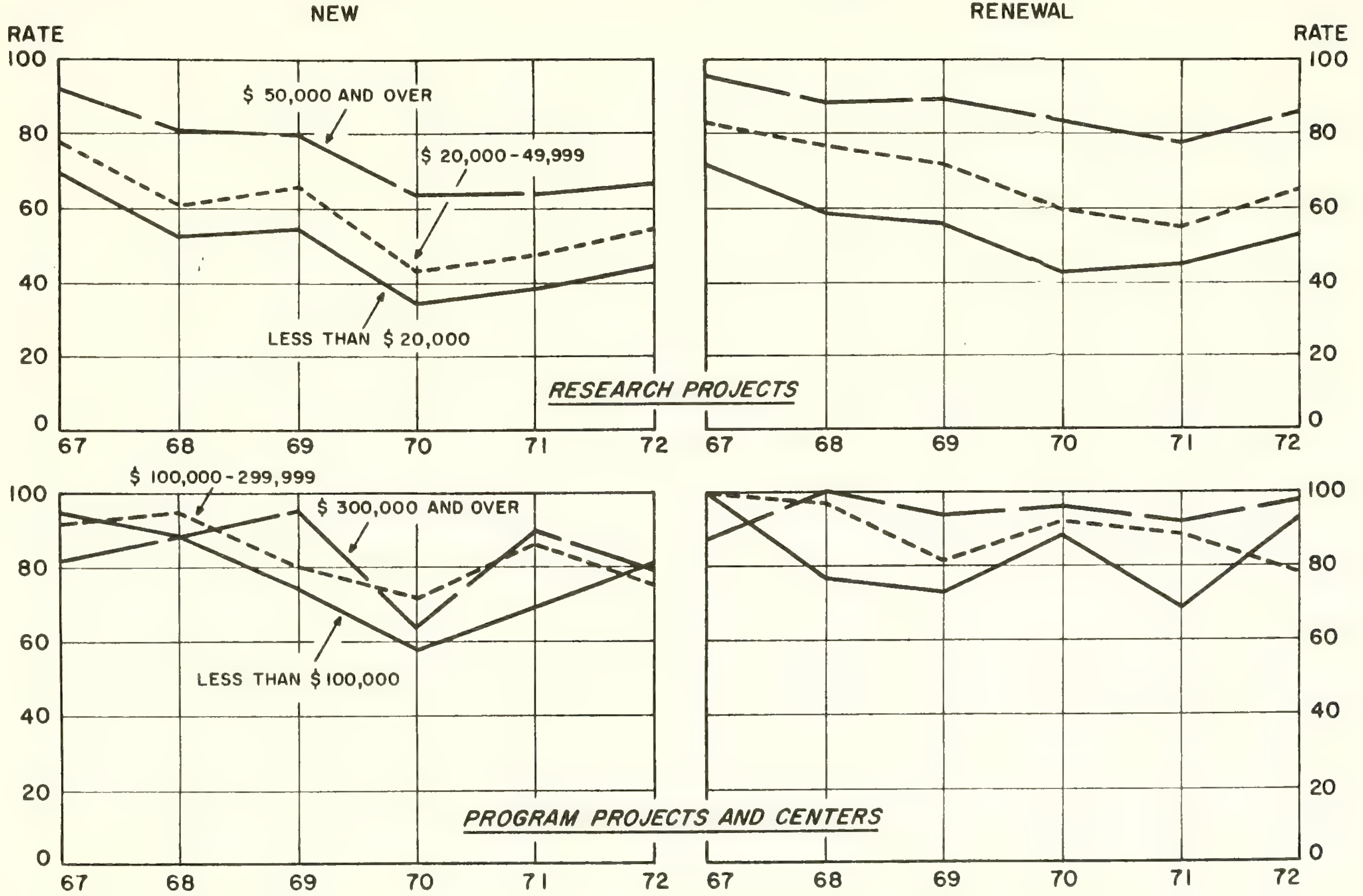
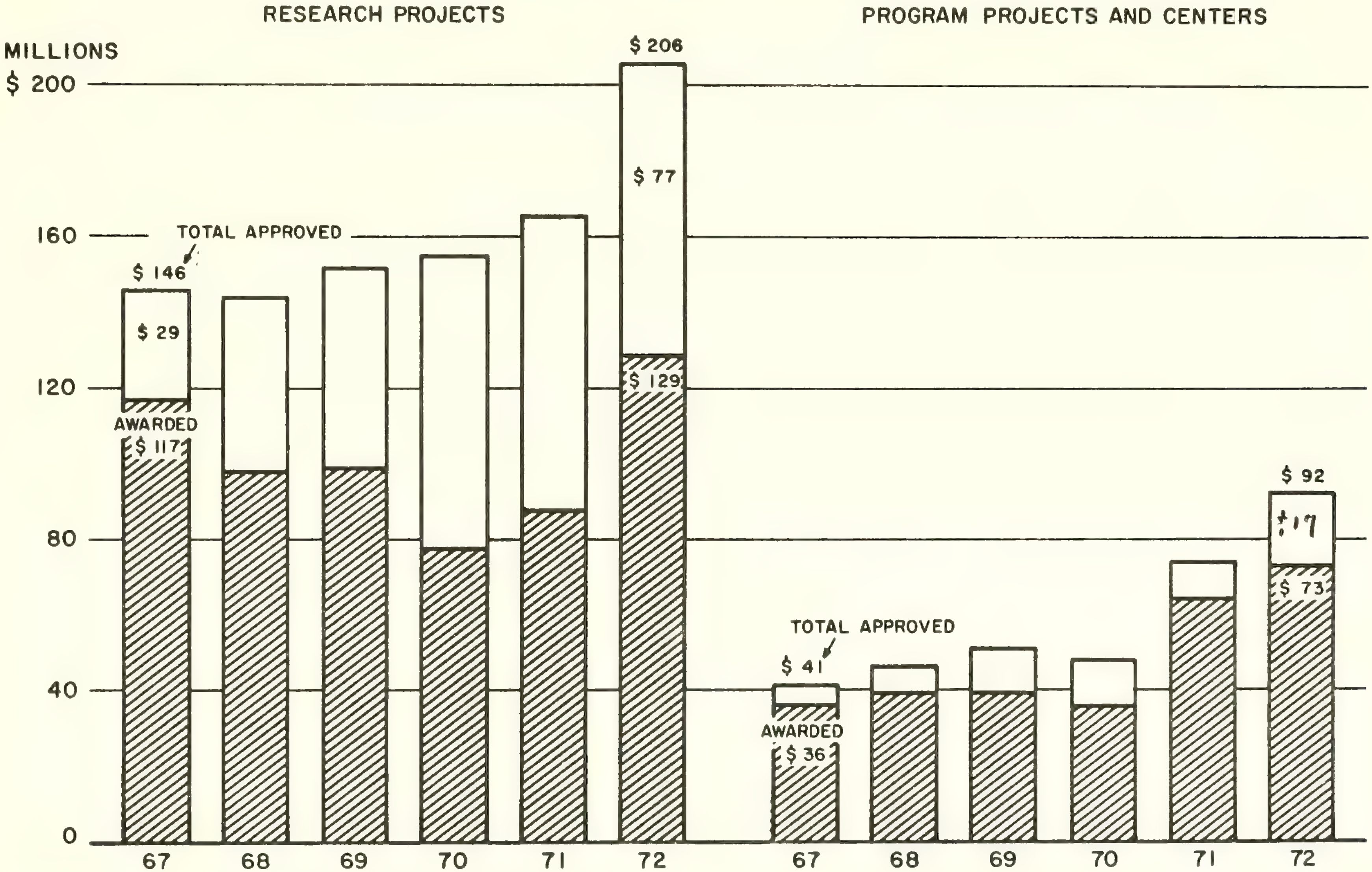


Figure 14

NIH RESEARCH PROJECT AND PROGRAM-PROJECT AND CENTER GRANTS APPROVED BY COUNCILS AND AWARDED, FY 1967-1972*



*INCLUDES DIRECT COSTS, COMPETING APPLICATIONS ONLY.

TAB 11

In 1947 NIH first formed an Office of Research Planning. The activities of this office were relatively modest--collecting, disseminating and publishing operating statistics on the research effort supported by the agency. In 1957, when Herb Rosenberg's organization was formed, the scope of activities was expanded to encompass a national view.

Planning in a Scientific Environment

"Planning" in scientific endeavor has a range of meanings that extend from curiosity-oriented basic research to systems realization or to an advanced stage of systems development. At different points on this range, planning has different connotations. For example, the ultimate character of an expected solution to the problem of aging could hardly be specified in concrete terms. On the other hand, expectations may at times be quite specific--e.g., a vaccine of describable properties. Thus, "planning" can mean very different things, depending on what type of problem is addressed.

Another ambiguity relates to the extent to which elements of a plan or program are integrated into a coherent unity. So long as the focus is on individual projects in basic research, a degree of clarity is possible. Individual scientists have definite plans for actions to be undertaken each day in their laboratories. But it is almost impossible in basic research to foresee the pivotal points at which intermediate or final solutions will occur. A science administrator supervising this type of loosely defined activity usually follows a strategy of giving each investigator

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The above was given as a speech by Dr. Thomas J . Kennedy, Jr. on June 4, 1973. It is a Keynote address for the Program Planning Session sponsored by the STEP Committee, NIH. Topic: Staff Training for Extramural Programs.

The best measure of priorities is the dollars allocated to the several programs in an organization. The allocation must reflect the "state of the art"--the scientific opportunities that exist--as well as the social importance of the problem--its public health significance. These aspects are referred to in some of the readings as part of an element in the collective preference profile. Scientific opportunity and importance of the problem can be objectively analyzed in terms of mortality and morbidity rates, age of the affected population, and the state of knowledge. These are clearly real-world considerations.

But once some of these parameters are identified and the specific problem is described, one begins to get into a complex calculus. Which is more important, a disease that is universally lethal but affects only a few people, or a disease of moderate severity that affects many people? Should effort be concentrated on people over 60 whose life expectancy is limited or on those in the early stages of life? These subjective elements hinge on what Alvin Wineberg talked about as the internal and external criteria for the worth of scientific activities. Why does a scientist or mathematician feel that of half a dozen possible proofs for a theorem, one is the most worthy? This element of subjective judgment, or taste, if you will, plays a large role in decisions about both the state of the art in science and the importance of problems. Institute directors make their personal marks on programs by their intuition in such matters.

At higher organizational levels, the tendency is to accept with minor reservations the technical assessment and recommendations

of the plan's originators. The reviewers then attempt to regard these assessments and recommendations as part of a larger problem set, in which the choices should be guided by a broader consideration of public interest and aspirations.

The emphasis at the level of the Office of the NIH Director is on developing, maintaining and updating a fiscal plan for NIH activities. The essential process for accomplishing this function is the allocation of marginal physical resources. Allocation decisions are influenced by consideration of program balance and by review of the significance of specific problems in a larger matrix of health missions.

Program balance has received a lot of recent attention. It has a number of aspects, and balance by category of disease is one of these. This is frequently reduced to an organizational question of balance between the institutes, which is more than a budgetary matter because each institute has its own constituency of grantees, scientific societies, voluntary agencies and so forth. The problem here is to seek optimal resource allocation within a framework provided by the realities of existing organizational boundaries. Perfect balance is an ever-moving but rarely reached target.

Another element in program balance relates to the question of who is directing research--whether it is Federally initiated or comes from the scientific community. Other elements include: the detail to which research objectives are specified--fundamental vs. applied research, or the degree of targeting; the extent to which research is supported through grants, through contracts and through direct

investigation by Federal employees; and the degree of investment in short- vs. long-term efforts.

The Office of the Director--in an attempt to define a national "collective preference"--must weigh the relative importance of the problems and opportunities that appear in the budget requests, the fiscal plans of the individual institutes, and the ways the plans of those institutes compete with one another. To accomplish this, the Office of the Director develops an NIH fiscal plan based on a synthesis of the scientific and fiscal plans presented by the several institutes. The NIH plan is defended at higher levels against the competing plans of other elements within the DHEW.

A second planning activity is to identify issues that transcend, or are shared by, the bureaus, institutes and research divisions and to develop "issue papers" relevant to them. One such issue recently examined was the appropriate level of funding for research in the United States. Once common problems have been identified, general solutions are sought. In one instance, a program to support construction of health research facilities emerged when a task force made up of Dr. K. M. Endicott from the OD staff and members of the several institutes found in a survey of academic institutions that there was virtually no remaining research space. As a result, the members recommended that NIH set up a program to assist academic institutions in providing such space. A more recent general solution to an issue was the Career Awards Program. This was developed in answer to the problem shared by NIH and the academic community of keeping

people in research and in academic institutions in order to train research workers. The solution was mutually satisfactory. Still another example was the development of the General Research Support Program in 1960 and, just before that, the development of the General Research Centers Program to meet a mutual need of all the NIH institutes and the community of research performers.

A third planning activity at the Office of the Director's level is the identification of data elements of general interest or utility for planning. Once the elements are identified, the data must be collected, analyzed and distributed. An example is the annual survey of Federal expenditures for biomedical research. Other examples are national manpower surveys (how many people are in training? in what fields? at what level in graduate school? and to what extent is the Government supporting them, etc.). A final example is the data obtained for specific subsectors of the performing community, such as the survey for the Committee on Academic Science and Engineering of the Federal Council for Science and Technology, which catalogs Federal, DHEW and NIH support to academic institutions for all academic purposes.

Planning at Higher Levels

At levels higher than NIH, the process of planning places less emphasis on technical questions and the state of the art but confronts a much longer list of possible choices. The criteria for choice involve social preference, and the decisions reflect much more the political process. Clearly, at the level of the Office of the Secretary

for Health, the range of choices is enormous. All plans for NIH must be considered against those, for example, of the Food and Drug Administration. It is interesting to speculate on whether the Assistant Secretary could modify agency plans or express preferences by viewing the NIH as one unit in competition with all other units under his control, or whether he could consider each NIH program in competition with all others in health, attempting for example to consider the merits of supporting the biology of the hepatitis virus against those of providing additional inspectors for the Food and Drug Administration. Practically, the problem cannot be handled in detail. At the level of an Assistant Secretary, judgments must be made between large blocs of money. Hopefully in the iteration of the processes, the distribution within the agencies and their subcomponents will be suitably adjusted. At the level of the Secretary the list of choices becomes even longer, and estimating what the public really wants and at what price becomes more difficult. At the level of the Office of Management and Budget, the problem is mind-boggling.

Yet several general statements can be made. For one, that *process* is as important, if not more so, than theory or ideology. To order objectively the many value conflicts inherent in budget formulation is clearly impossible. Questions of great significance are thus resolved in a somewhat disorderly and illogical manner. A certain openness characterizes the tentative judgments represented in the President's budget. All parties concerned have the opportunity to state their views in the course of congressional hearings. Then

somehow a resolution that comes close to doing what the public wants to have done with its funds emerges.

A second general statement is that there is a limited degree of freedom at every level. Many uncontrollables must be recognized. The uncontrollables peculiar to the NIH are our moral commitments. At higher levels, there are items uncontrollable by law--statutes under which we provide for formula payments to individuals, organizations or political jurisdictions (Social Security, aid for dependent children, etc.). Since these uncontrollables must be included in the budget each year, and as long as the total budget is relatively constant, increases in the uncontrollables reduce the amounts available for discretionary expenditures. Moreover, "sacred cows" are found in the budget at every level. For example, whatever merit one attaches to the amount of money in special programs such as sickle cell anemia or Cooley's anemia, it is politically unthinkable to touch them at this time. As a result of these phenomena, the margin for change is much smaller than the overall size of the budget. As a corollary, major changes must be effected over a substantial length of time.

A third general statement is that it is easy to become cynical about this process, particularly when you sit in the front office at NIH and see events suddenly emerge to make a mockery out of a year's work. Sudden decisions to double budgets in certain areas or to eliminate programs make one feel that all the rational analysis has been futile--that the whole business of planning is nothing but a game of politics, and one is a helpless actor on a very large stage

with a very small part to play. On the other hand, someone working in this field can only develop as logical and rational a basis as possible for the domain for which he is responsible. It may not always carry the day. I think that most planners feel that: they get up to bat frequently; their batting average is low, with many strike-outs; and every now and then they hit one out of the park. These occasional triumphs constitute the real pleasure that rewards the planner's labors.

TAB 12

OUTLINE 3
W.T. Carrigan
5/11/73

PROSPECTS FOR REDERAL SUPPORT
OF BIOMEDICAL RESEARCH*

Thomas J. Kennedy, Jr., M.D.**

I. An attempt to assess the prospects for Federal support of biomedical research might well focus primarily on the research award programs of the National Institutes of Health, which is the major contributor to medical research in this country and a bellwether among supportive Federal agencies.

II. First, however, I'd like to show you a chart--the first slide, please: all obligations for biomedical R&D in the United States since 1960.

   A. The bars indicate that medical research has grown apace.

   B. There has been a remarkable consistency between the public and private sectors for at least a decade.

   C. The bars, however, overstate the growth in real terms. At 1967 prices, we could have bought the R&D represented by the heavy lines--more prior to 1967 and less since then. We see that there have actually been gains (in the aggregate) despite inflation.

III. NIH, in 1972, funded 38 percent of all U.S. biomedical research and about 60 percent of the Federal. The next slide (2) shows the relative importance of NIH programs in three universes of Federal support. NIH accounts for--

   A. 8 percent of all Federal R&D,

   B. 40 percent of Federal Funds for R&D at educational institutions, and

   C. 37 percent of Federal funds for academic science--R&D, training, facilities, and resources.

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*Prepared for delivery before the Society of Developmental Biology, Inc., Manhattan, Kansas, 6/15/73.

**Associate Director for Program Planning and Evaluation, National Institutes of Health, U.S. Dept. of Health, Education, and Welfare.

IV. The budget for FY 1974 will bring major changes in the way NIH funds are deployed. Slide, please (3).

A. The program balance will shift in terms of--

1. Areas of study, or health problems emphasized, and

2. Program strategy--that is, degree of central direction--as indicated by instruments of support.

B. The slide represents the 1974 President's Budget for the NIH institutes and research divisions, by program (appropriations), showing the 1973 and '74 columns and the change.

1. The institutes and research divisions would rise $48 million, net.

2. An upward trend in cancer and heart continues, while all the other programs decline.

3. The severest cut is in the National Institute of General Medical Sciences--competing project grants.

4. Most of the cut in the Division of Research Resources is in general research support grants (formula grants to institutions), which are to be drastically scaled down.

C. The next slide (4) turns the budget around to show the composite activity structure.

1. Research training is being phased out in favor of a "free market" for graduate education. The Administration takes the position that medical R&D funds should suffice to attract students into the field, even to the extent that they would finance their own advance education. The Government may assist by underwriting loans.

2. Total NIH research funds--grants and direct operations--would rise from $1,281 million for FY 1973 to $1,352 million for '74--a 5 percent increase.

a. The lion's share of the increase--$45 of $71 million--would go for R&D contracts, particularly in cancer and heart.

3. It should be pointed out that the increased use of contracts is not necessarily detrimental to basic research.

a. In the institutes totally, as shown in the next slide (5), two-thirds of the research contract funds are going to nonprofit institutions--45 percent to schools. Only a third are going to industry.

b. The next slide (6) shows that cancer is exceptional in

awarding only 52 percent of its contract funds to the nonprofit sector.

c. In the cancer and heart institutes, contracts are being used increasingly to support basic investigation as well as developmental efforts.

V. Within the institute programs, there are major trends that we might examine more closely.

A. I have already mentioned one, illustrated in the next slide (7): the expansion of the cancer and heart programs, which together account for nearly 50 percent of the 1974 research and training budget. This is the shift in health problem emphasis.

1. Some of the current "targeted" programs are identified in the next slide (8).

2. There is a tendency for certain programs to be protected as a result of special legislation, earmarking of funds, etc. As shown in the next slide (9), these tend to fare better than other biomedical research.

B. Another trend, shown in the next slide (10), is the increasing use of R&D contracts and special, larger grants--namely, program-project and center grants. This is the shift in instruments of support.

1. A percentage distribution of the same data, as shown in the next slide (11), reflects the aggregate rise in relative importance of the targeted programs. Research contracts and centers are big business now at NIH.

2. The next slide (12) shows rather dramatically how this change is distributed by institute. It is very strongly attributable to programming in cancer, in heart and lung, and in child health and human development.

a. Note that there is also some absolute growth in the regular, or research project, grants in the three unusual institutes.

b. The aggregate programs of the remaining institutes will decrease by 10 or 11 percent between FY 1972 and '74.

c. The next and last slide (13)--again a percentage distribution of the same data--points up the contrast between the two groups of programs.

C. Thus we see two forces affecting program balance:

1. Certain institutes--mainly cancer, heart and child health--are moving, by means of contracts and special grants, toward targeted or applied research, with more central direction, more mission orientation, more relevance to socially important health problems.

2. The other institutes continue in the vein of more evenness between directed, applied approaches and undifferentiated, basic science.

3. This percentage distribution highlights the differences in approach. Lights, please.

VI. Some further implications: The NIH is in the process of transforming its research apparatus. Within three of the institutes particularly, a different approach to research--stronger central direction--is manifest. They are changing their way of doing business.

A. One effect of the special grants is that larger segments of the NIH program are amenable to local control at the institutional level.

B. These trends in research support are consistent with policy stated as early as July 1967--a policy of identifying opportunities for applied, or targeted, research and of mounting programs to exploit them.

C. On the other hand, it was not envisioned that cancer and heart research would be advanced at the expense of equally productive efforts against other diseases.

D. We are back to the matter of program balance: given a limited sum of money, how should it be deployed (1) over the Nation's health problems and (2) with what degree of central control?

1. There is no right or wrong answer--only one of consensus in terms of scientific and administrative judgment.

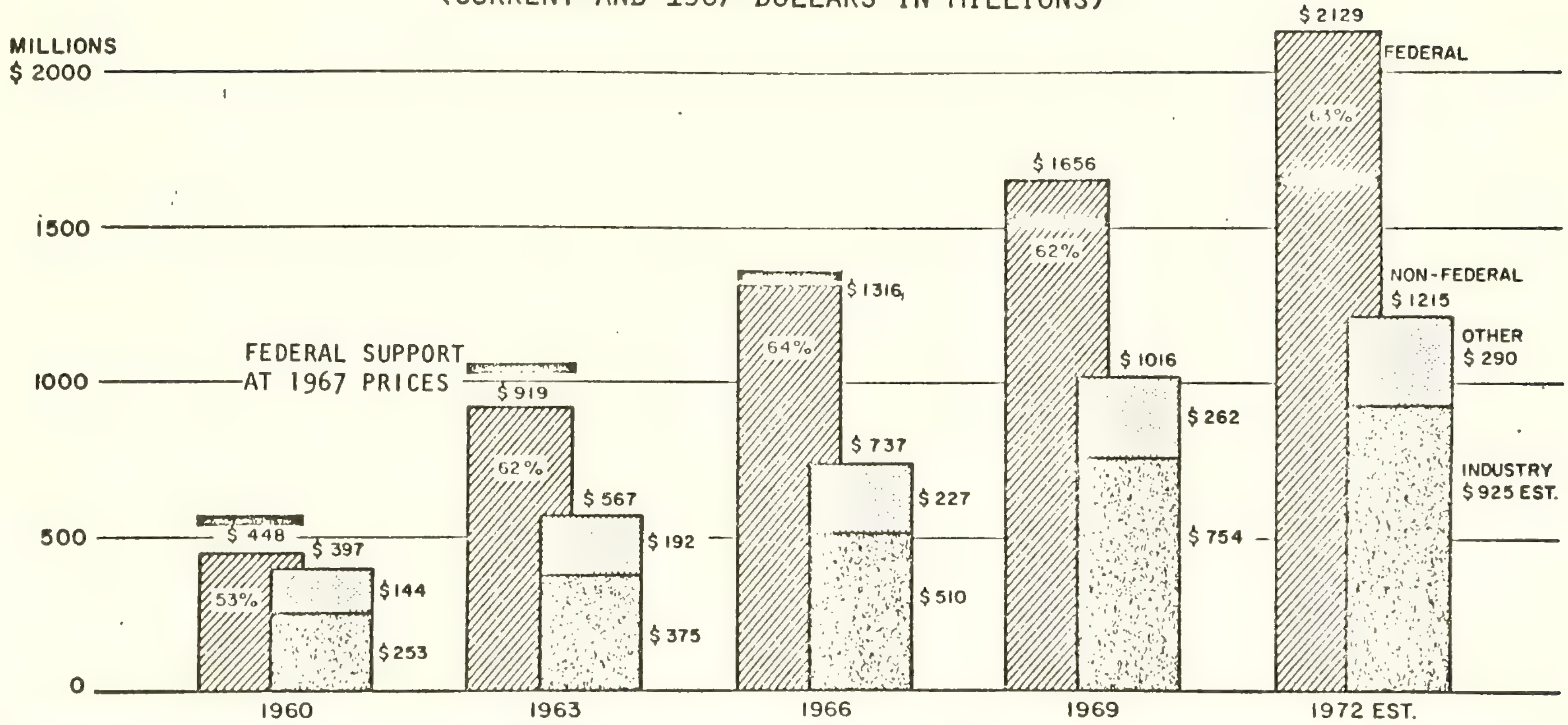
2. Your direct expression, either to us or through your scientific societies, would be valuable.

E. It may be safely predicted that as programs mature in all the institutes, a shift toward contracts and center grants, with a view to advancing Federal missions to conquer disease, will be the shape of things to come.

Figure 1

FUNDS FOR MEDICAL R&D BY SOURCE*
UNITED STATES, 1960-1972 EST.

(CURRENT AND 1967 DOLLARS IN MILLIONS)

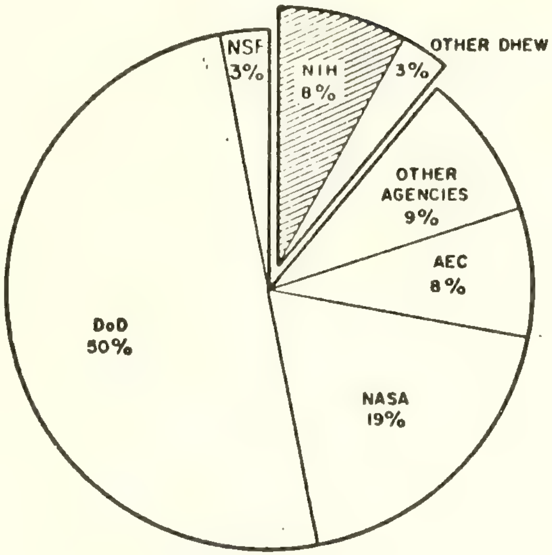


*COVERS ONLY MEDICAL AND HEALTH-RELATED R & D — NO TRAINING OR CONSTRUCTION. NON-FEDERAL DATA SINCE 1964 ARE NOT STRICTLY COMPARABLE WITH THOSE FOR PRIOR YEARS, AS COVERAGE HAS BEEN IMPROVED.

Figure 2

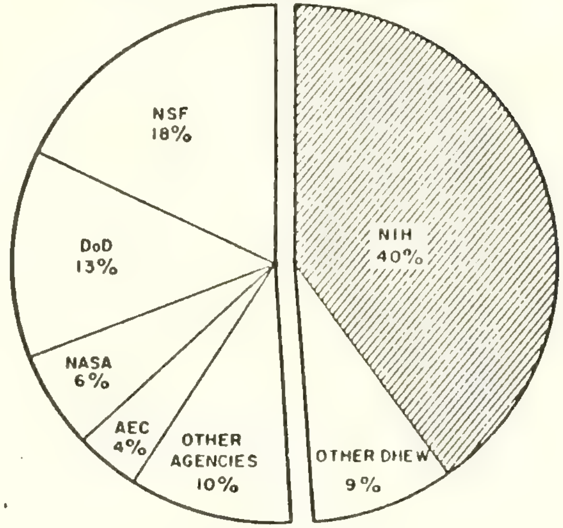
NIH ACCOUNTS FOR–

8% OF ALL FEDERAL R & D



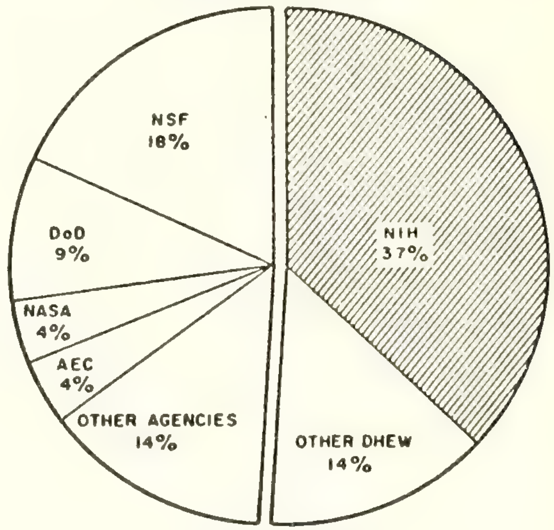
$ 16.5 BILLION

40% OF FEDERAL FUNDS FOR R & D AT EDUCATIONAL INSTITUTIONS



$ 1.9 BILLION

37% OF FEDERAL FUNDS FOR ACADEMIC SCIENCE†



$ 2.6 BILLION

FEDERAL SUPPORT, FY 1972 (IN MILLIONS)

AGENCY	R & D	EDUC. INSTITUTIONS*	
		R & D	ACADEMIC SCIENCE†
TOTAL	$ 16,500	$ 1,906	$ 2,606
DHEW	1,763	936	1,327
NIH	1,267	763	962
OTHER	496	173	365
NSF	456	335	459
DoD	8,294	244	244
NASA	3,183	122	119
AEC	1,298	87	95
OTHER	1,506	192	362

SOURCE FOR TOTAL R & D: *SPECIAL ANALYSIS, BUDGET OF THE U.S. GOVT., FY 1974*, GPO 1973.
SOURCE FOR ACADEMIC R & D AND ACADEMIC SCIENCE: NSF AND NIH.

*ESTIMATED. †R & D, TRAINING, FACILITIES, RESOURCES.

Figure 3

NIH INSTITUTES AND RESEARCH DIVISIONS
FY 1974 PRESIDENT'S BUDGET*
Summary by Program, Obligations in Thousands

	1973	1974	Change
Total	$1,483,648	$1,531,776	+48,128
Cancer	426,400	500,000	+73,600
Heart	247,075	265,000	+17,925
Dental	40,333	38,452	- 1,881
Arthritis	139,806	133,608	- 6,198
Neurology	105,539	101,198	- 4,341
Allergy	100,726	98,693	- 2,033
General medical sciences	151,587	138,573	-13,014
Child health	109,551	106,679	- 2,872
Eye	33,797	32,092	- 1,705
Environmental health	25,889	25,263	- 626
Research resources	99,019	88,632	-10,387
International center	3,926	3,586	- 340

*2/16/73.

Figure 4

NIH INSTITUTES AND RESEARCH DIVISIONS
FY 1974 PRESIDENT'S BUDGET*
Summary by Activity, Obligations in Thousands

	1973	1974	Change
Total	$1,483,648	$1,531,776	+48,128
Research grants	812,415	826,518	+14,103
Regular programs	587,044	582,882	- 4,162
Gen. res. support	26,124	17,000	- 9,124
Other special grants	199,247	226,636	+27,389
Direct operations	468,773	525,264	+56,491
Labs & clinics	117,933	123,624	+ 5,691
R&D contracts	243,659	288,241	+44,582
Collab. res.	48,888	49,934	+ 1,046
Other direct	58,293	63,465	+ 5,172
Research training	149,460	125,994	-23,466
Training grants	112,783	95,402	- 6,085
Fellowships	36,677	30,592	-17,381
Cancer control	4,000	34,000	+30,000
Cancer construction	49,000	20,000	-29,000

*2/16/73.

FUNDS AWARDED IN NIH RESEARCH CONTRACTS, BY INSTITUTE AND PERFORMER, FY 1971 AND 1972

(Dollars in millions)

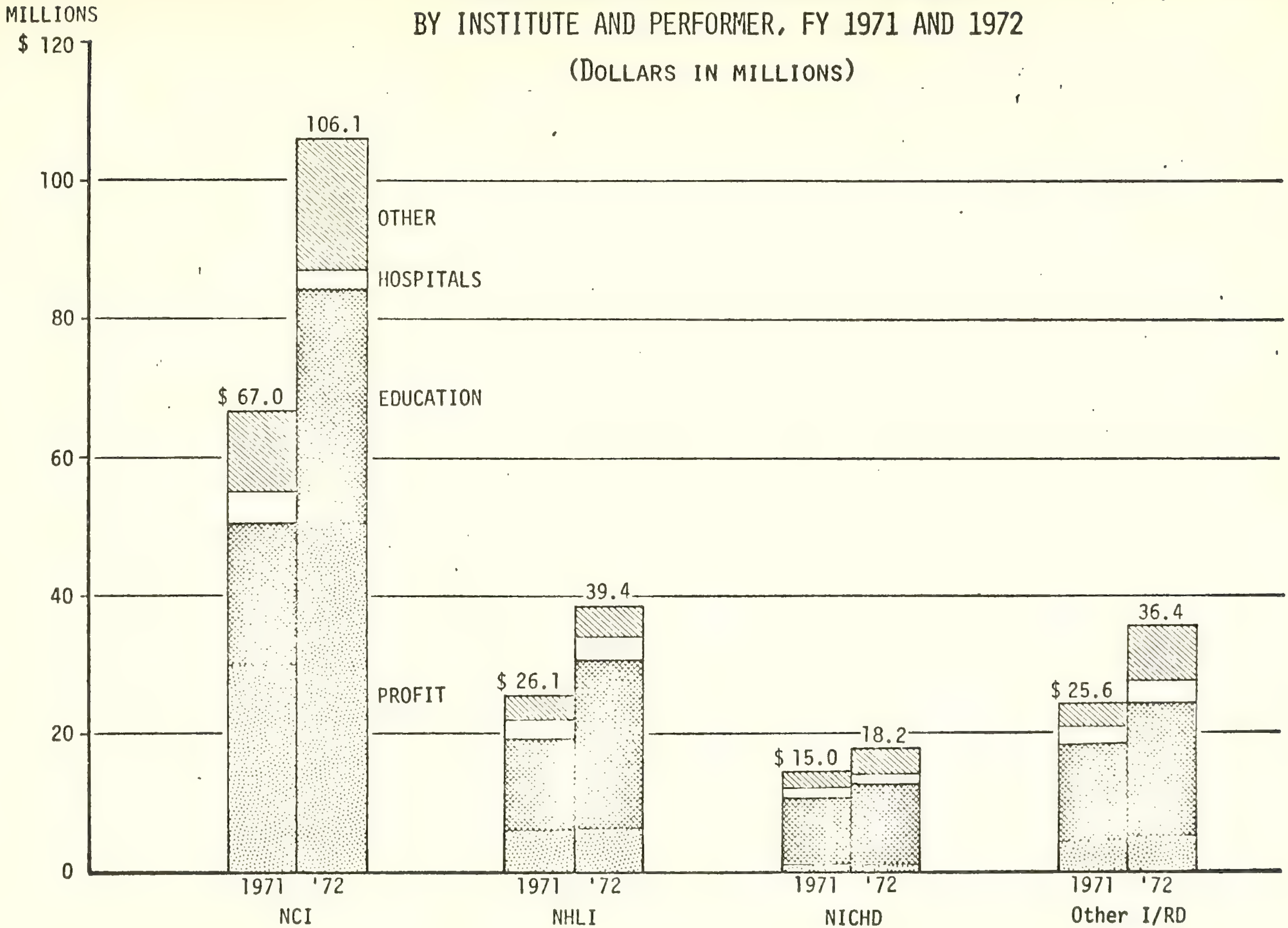


Figure 6

PERCENTAGE DISTRIBUTION OF FUNDS AWARDED IN NIH RESEARCH CONTRACTS, BY INSTITUTE AND PERFORMER, FY 1971 AND 1972

(DOLLARS IN MILLIONS)

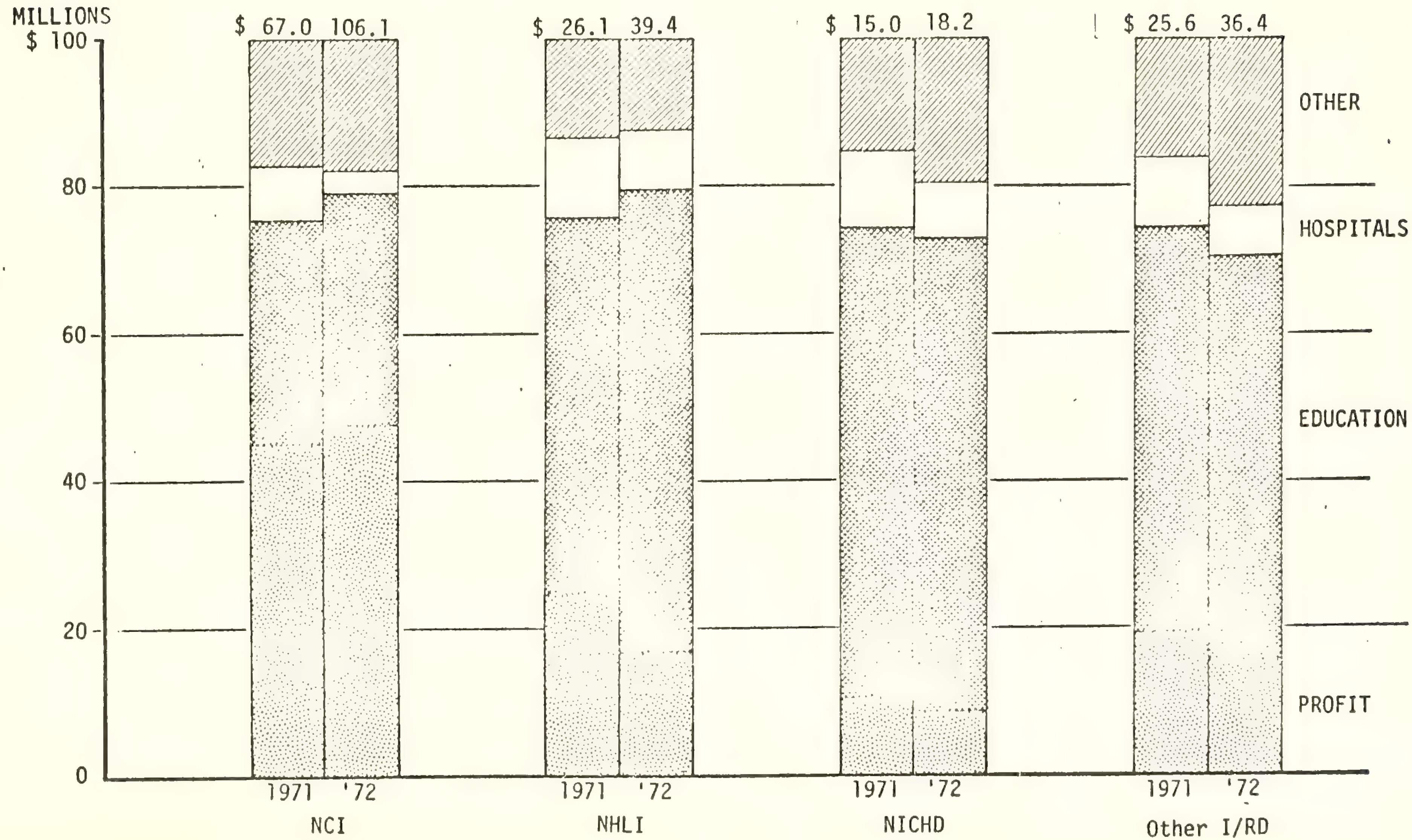


Figure 7

PERCENTAGE DISTRIBUTION OF NIH FUNDS
FOR RESEARCH AND TRAINING, EXCLUDING PROGRAMS TRANSFERRED OUT*
CONSOLIDATED FY 1950-1974(EST.) APPROPRIATIONS

*Excludes NIMH, DBS, community programs, and construction. FY 1973 and 1974 from 1974 President's Budget of 1/15/73. †DRG, NIGMS, DRR, GRS-NIH.

Figure 8

NIH FUNDS OBLIGATED FOR SELECTED "TARGETED" PROGRAMS, FY 1973

(IN THOUSANDS OF DOLLARS)

Institute	Program	Contracts	Other	Total
NCI	Cancer Chemotherapy	$40,555	$16,508	$57,063
	Special Virus Cancer	42,204	6,855	49,059
	Chemical Carcinogenesis	22,649	3,584	26,233
	Cancer Task Forces	12,371	4,661	17,032
NHLI	Arteriosclerosis	25,457	68,124	93,581
	Heart Co-op. Drug	500	4,900	5,400
	Sickle Cell Disease	5,761	9,239	15,000
	Medical Devices	11,572	600	12,172
NIDR	Dental Caries	3,559	5,138	8,697
NIAMDD	Artificial Kidney/ Chronic Uremia	4,319	601	4,920
NINDS	Collaborative Perinatal	3,500	1,926	5,426
NIAID	Interferon/Antiviral	900	5,504	6,404
	Immunoprophylaxis	3,000	3,165	6,165
NICHD	Population Research	15,009	24,835	39,844
	TOTAL	$191,356	$155,640	$346,996

Figure 9

GROWTH OF SPECIALLY
PROTECTED NIH PROGRAMS,
FYs 1968 AND 1973 EST.*

(DOLLARS IN MILLIONS)

	1968	1973	% change
Total NIH research	$1,066.9	$1,483.6	39%
Protected programs, total	423.7	803.9	90
NCI, total	183.4	426.4	132
Cancer chemotherapy	(26.3)	(57.1)	117
Cancer virology	(19.5)	(49.1)	152
NHLI, total	168.0	247.1	47
Arteriosclerosis	(31.8)	(93.6)	194
Sickle cell disease	(0.9)	(15.0)	1567
Dental caries	1.0	8.7	770
Digestive diseases	13.3	16.2	22
Child health	36.6	53.4	46
Population/reproduction	13.5	39.8	195
Aging	8.0	12.3	54
All other biomedical research	643.2	679.7	6
--of which:			
NIAMDD less dig. dis.	131.9	123.6	-6
Arthritis	(11.1)	(14.2)	28
Cystic fibrosis	(2.0)	(2.6)	30
Diabetes	(7.5)	(7.4)	-1
NIAID, total	94.4	100.7	7
NIGMS, total	160.3	151.6	-5
Fundamental science	(74.3)	(57.1)	-23
NIEHS	17.3	25.9	50

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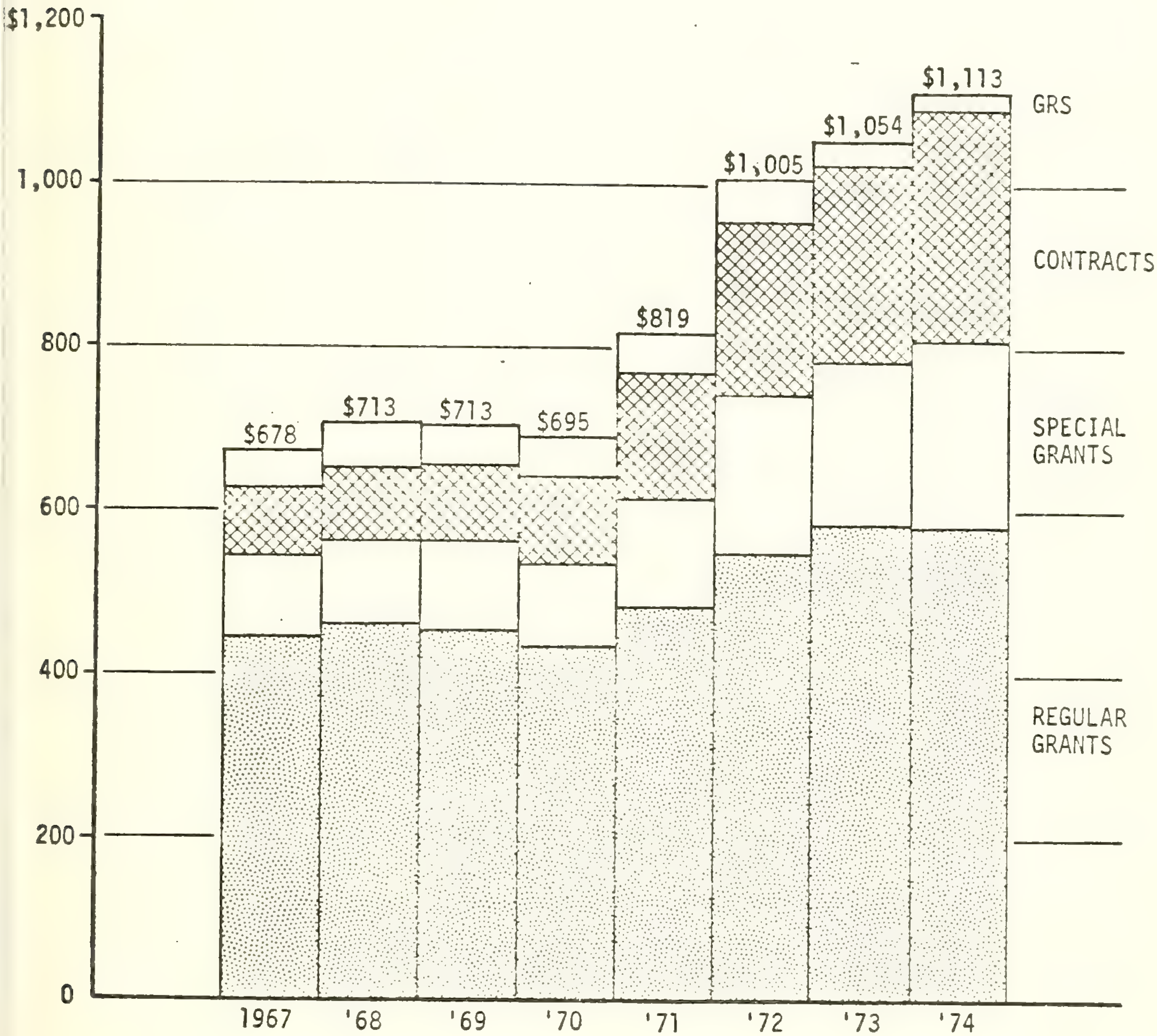
*Includes research training.

Figure 10

FUNDS OBLIGATED FOR NIH RESEARCH GRANTS AND CONTRACTS, FY 1967-1974*

(DOLLARS IN MILLIONS)

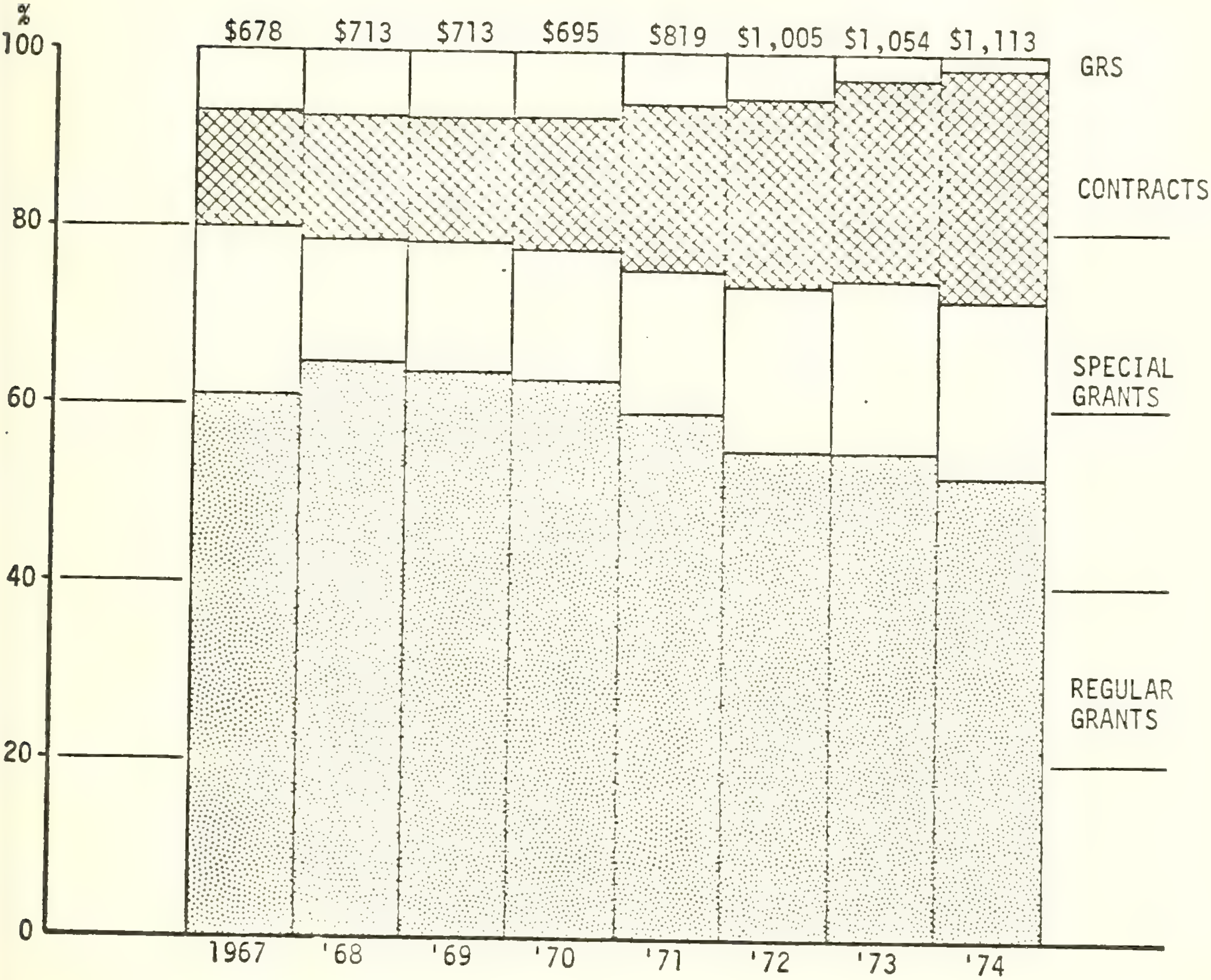


*FY 1973 and 1974 from President's Budget of 2/16/73.

Figure 11

PERCENTAGE DISTRIBUTION OF FUNDS OBLIGATED FOR NIH RESEARCH GRANTS AND CONTRACTS, FY 1967-1974*

(DOLLARS IN MILLIONS)

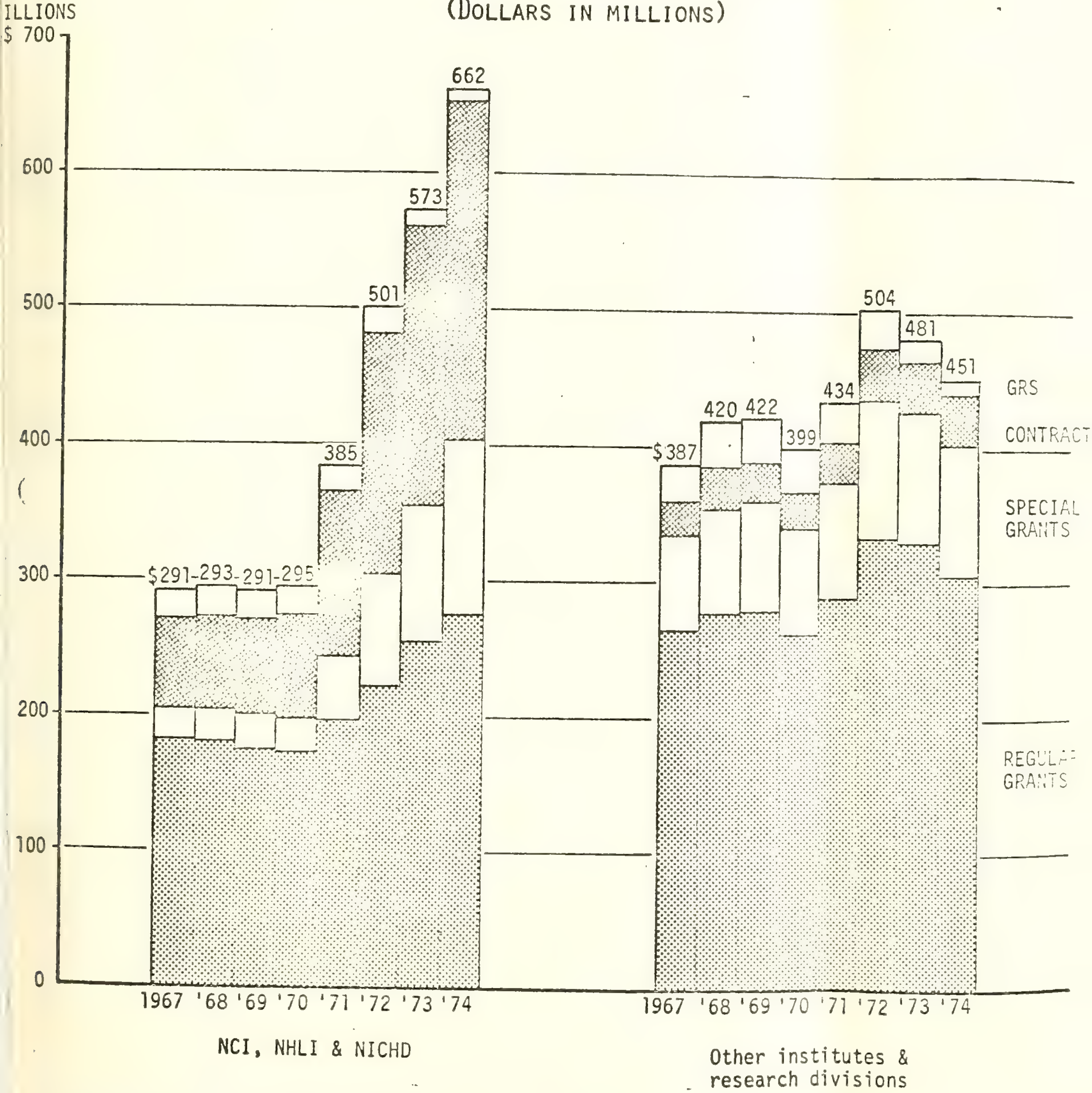


*FY 1973 and 1974 from President's Budget of 2/16/73.

Figure 12

FUNDS OBLIGATED FOR NIH RESEARCH GRANTS AND CONTRACTS BY INSTITUTES (GROUPED) AND TYPE OF PROGRAM, FY 1967-1974*

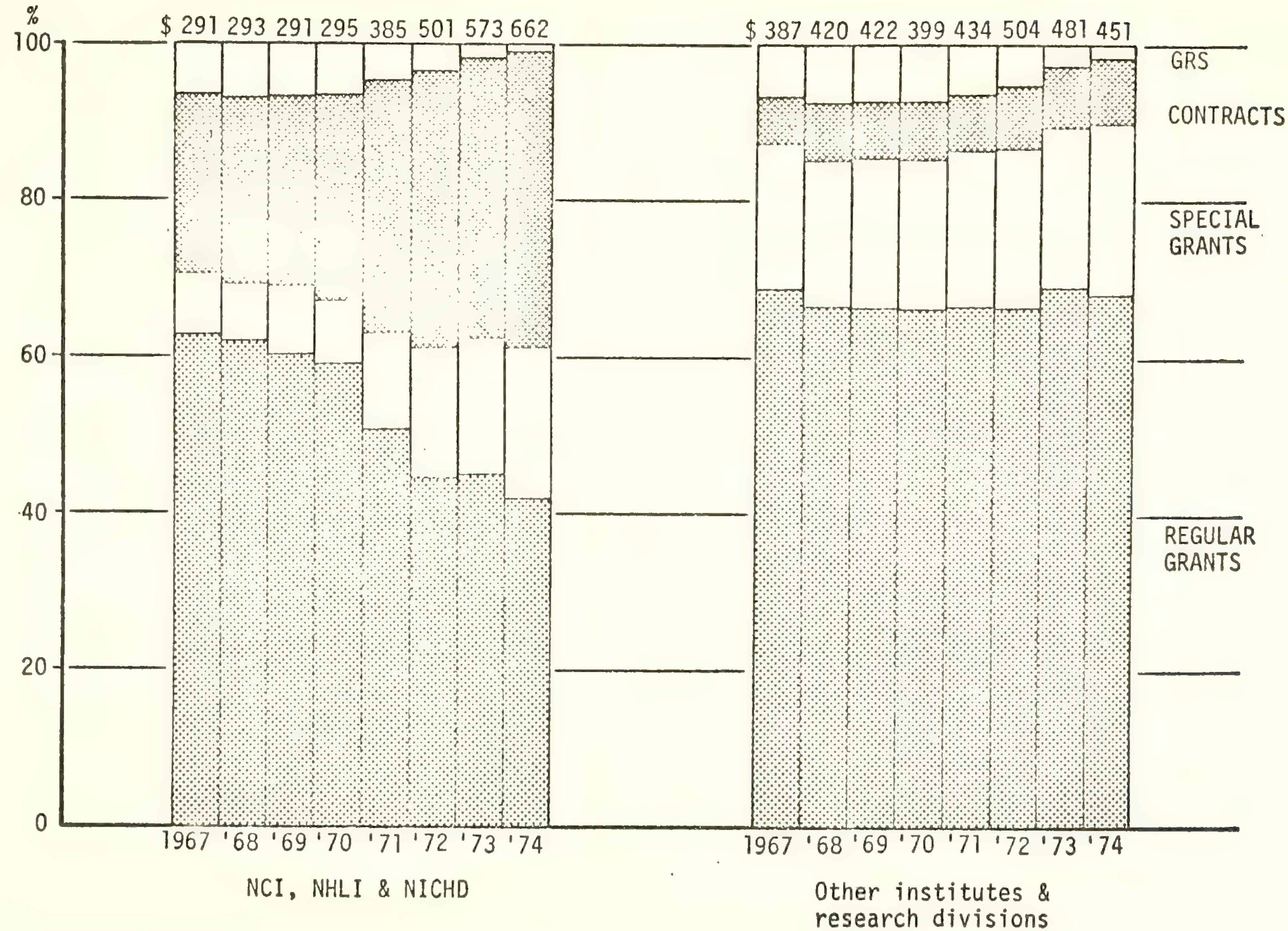
(DOLLARS IN MILLIONS)



*FY 1973 and 1974 from President's Budget of 2/16/73.

PERCENTAGE DISTRIBUTION OF FUNDS OBLIGATED FOR NIH RESEARCH GRANTS AND CONTRACTS BY INSTITUTES (GROUPED) AND TYPE OF PROGRAM, FY 1967-1974*

(DOLLARS IN MILLIONS)



*FY 1973 and 1974 from President's Budget of 2/16/73.

TAB 13

File Copy

\# 7/4

DIRECTOR'S ADVISORY COMMITTEE

NIH

Dr. Thomas J. Kennedy

6/26/73

Order M1

NIH RESEARCH GRANTS BY DOLLAR-AWARD INTERVAL, FY 1972*

(DOLLARS IN MILLIONS)

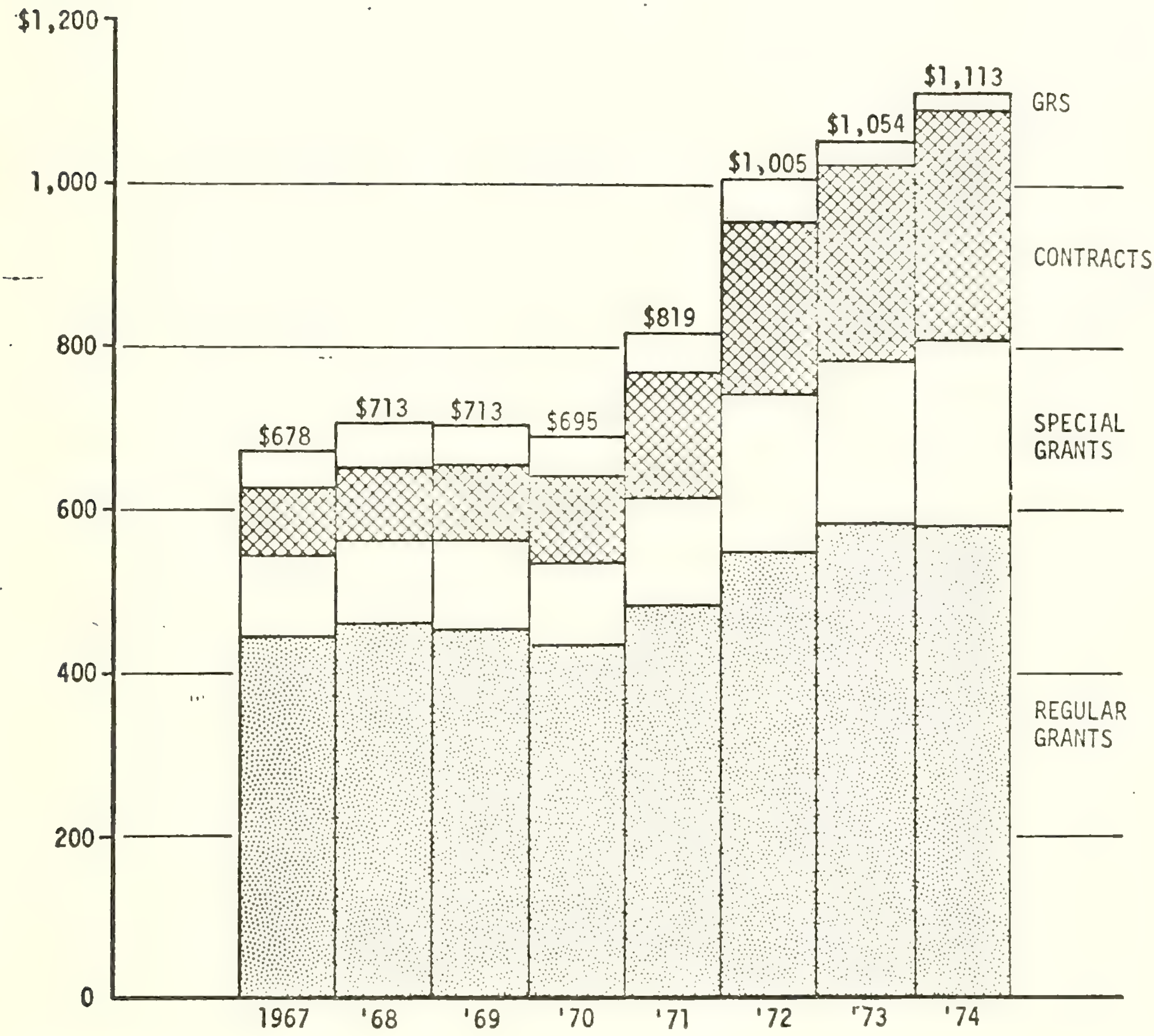
DOLLAR AWARD INTERVALS (IN THOUSANDS)	REGULAR RESEARCH PROJECTS		RESEARCH PROGRAM PROJECTS		GEN. CLIN. RESEARCH CENTERS		OTHER RESEARCH CENTERS	
	NUMBER	AMOUNT	NUMBER	AMOUNT	NUMBER	AMOUNT	NUMBER	AMOUNT
TOTAL	9562	$448.3	477	$156.9	83	$42.1	265	$94.0
$0 - 25	1977	35.4	2	.0	-	-	12	.1
$25 - 50	4510	164.5	5	.2	-	-	22	.9
$50 - 75	1932	116.5	21	1.4	-	-	27	1.7
$75 - 100	653	55.8	22	1.9	-	-	23	2.0
$100 - 150	338	39.9	68	8.4	1	.1	27	3.4
$150 - 200	75	12.8	68	12.0	-	-	21	3.6
$200 - 250	42	9.2	44	9.7	2	.5	10	2.3
$250 - 300	15	4.2	52	14.3	4	1.1	10	2.7
$300 - 350	3	1.0	45	14.4	10	3.3	15	4.9
$350 - 400	7	2.6	40	15.0	11	4.0	17	6.4
$400 - 450	2	.8	24	10.2	11	4.7	9	3.8
$450 - 500	-	-	24	11.4	10	4.7	13	6.1
$500 - 550	2	1.0	10	5.2	5	2.6	5	2.6
$550 - 600	-	-	6	3.5	6	3.4	7	4.0
$600 - 650	3	1.9	11	6.9	5	3.0	4	2.5
$650 - 700	-	-	3	2.0	4	2.7	5	3.4
$700 - 750	1	.7	4	2.9	2	1.4	6	4.3
$750 - 800	1	.8	3	2.3	2	1.5	3	2.3
$800 - 850	-	-	5	4.1	5	4.2	6	4.9
$850 - 900	-	-	3	2.6	1	.9	-	-
$900 - 950	-	-	4	3.7	1	.9	3	2.8
$950 - 1000	-	-	-	-	2	2.0	1	1.0
$1000 - 7000	1	1.1	13	24.6	1	1.0	19	28.2

*Number columns exclude all supplemental awards; amount columns exclude supplements to previous years' awards.

Order M19

FUNDS OBLIGATED FOR NIH RESEARCH GRANTS AND CONTRACTS, FY 1967-1974*

(DOLLARS IN MILLIONS)

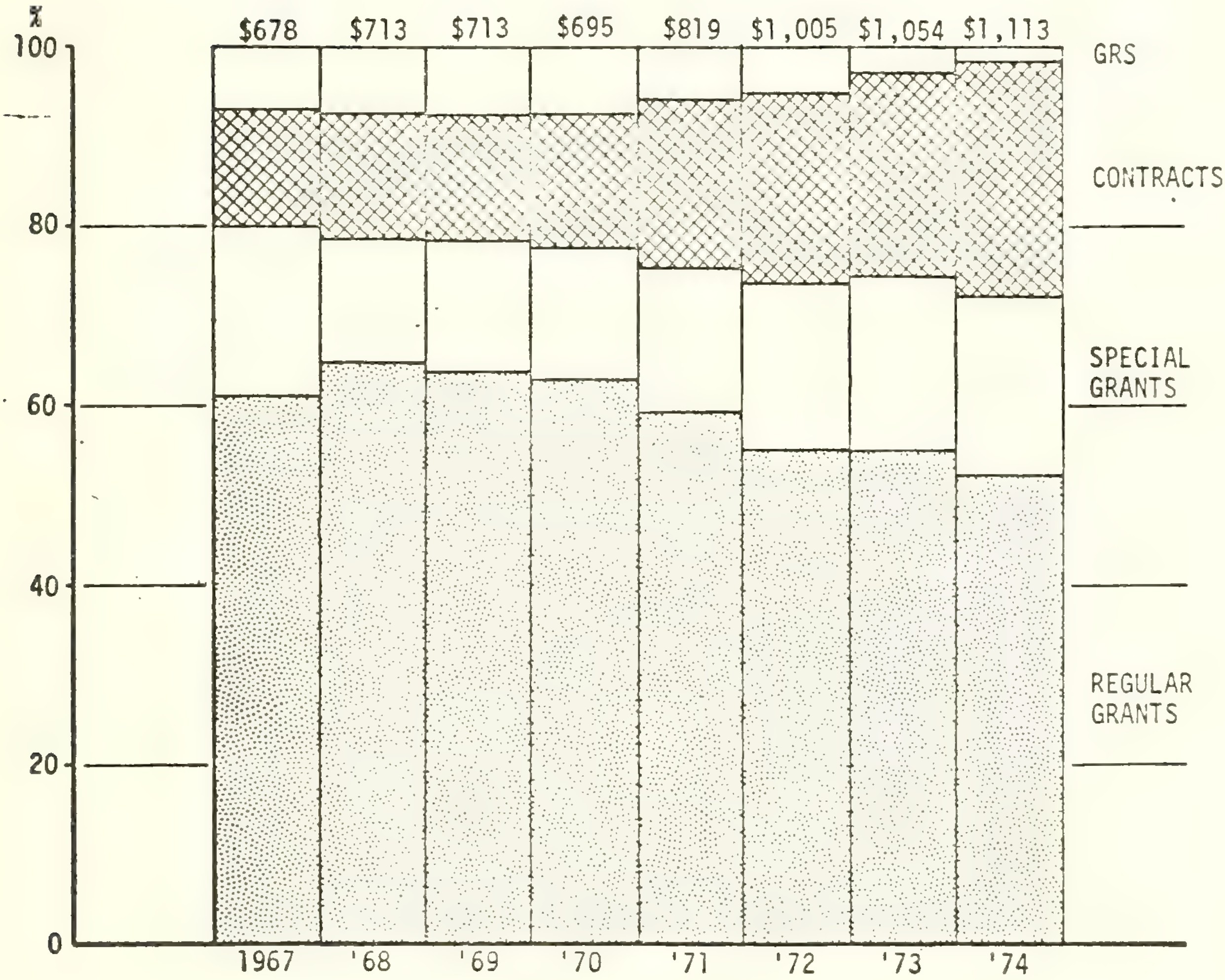


*FY 1973 and 1974 from President's Budget of 2/16/73.

Order M20

PERCENTAGE DISTRIBUTION OF FUNDS OBLIGATED FOR NIH RESEARCH GRANTS AND CONTRACTS, FY 1967-1974*

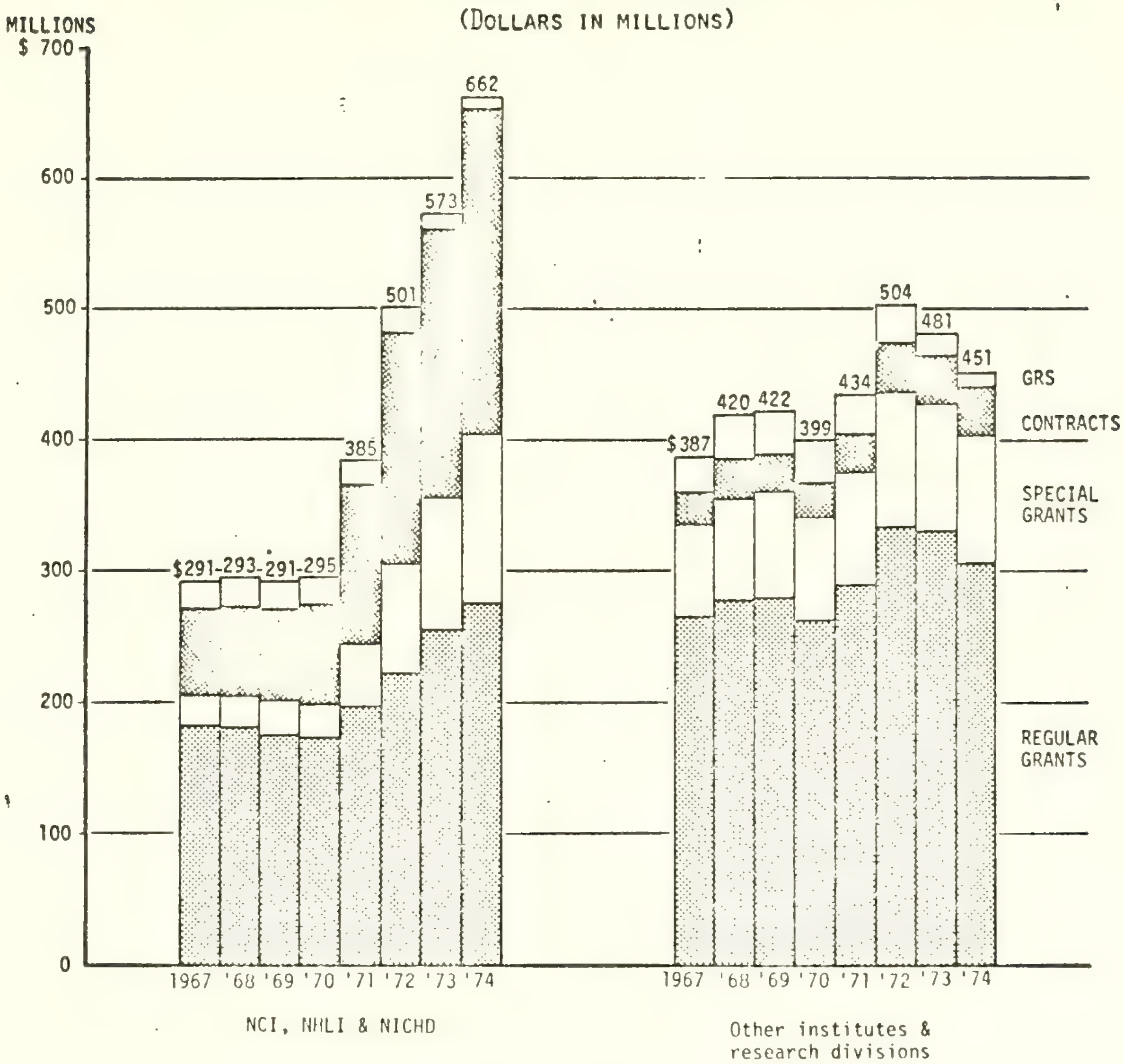
(DOLLARS IN MILLIONS)



*FY 1973 and 1974 from President's Budget of 2/16/73.

FUNDS OBLIGATED FOR NIH RESEARCH GRANTS AND CONTRACTS BY INSTITUTES (GROUPED) AND TYPE OF PROGRAM, FY 1967-1974*

(DOLLARS IN MILLIONS)

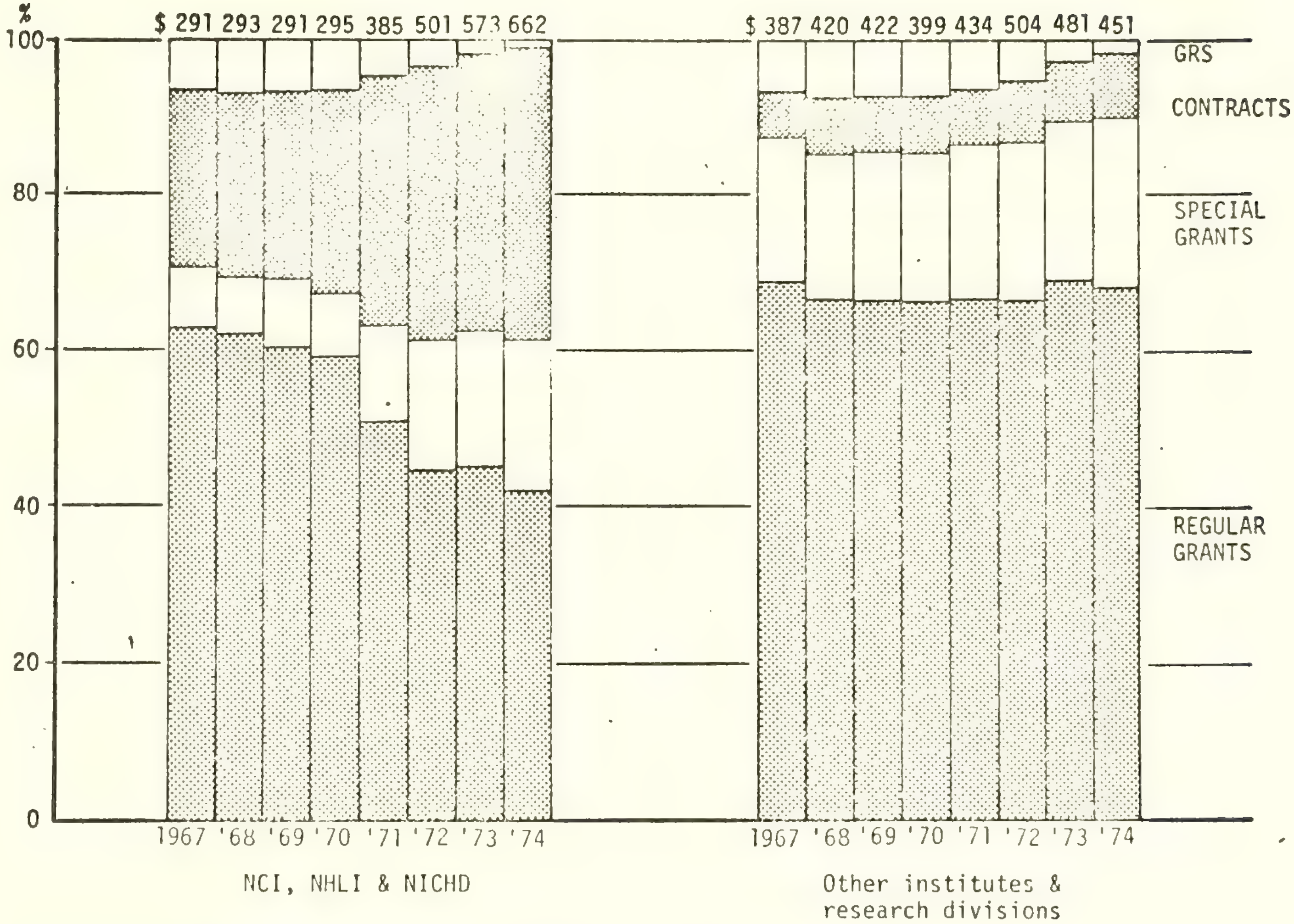


*FY 1973 and 1974 from President's Budget of 2/16/73.

Order M 21

PERCENTAGE DISTRIBUTION OF FUNDS OBLIGATED FOR NIH RESEARCH GRANTS AND CONTRACTS BY INSTITUTES (GROUPED) AND TYPE OF PROGRAM, FY 1967-1974*

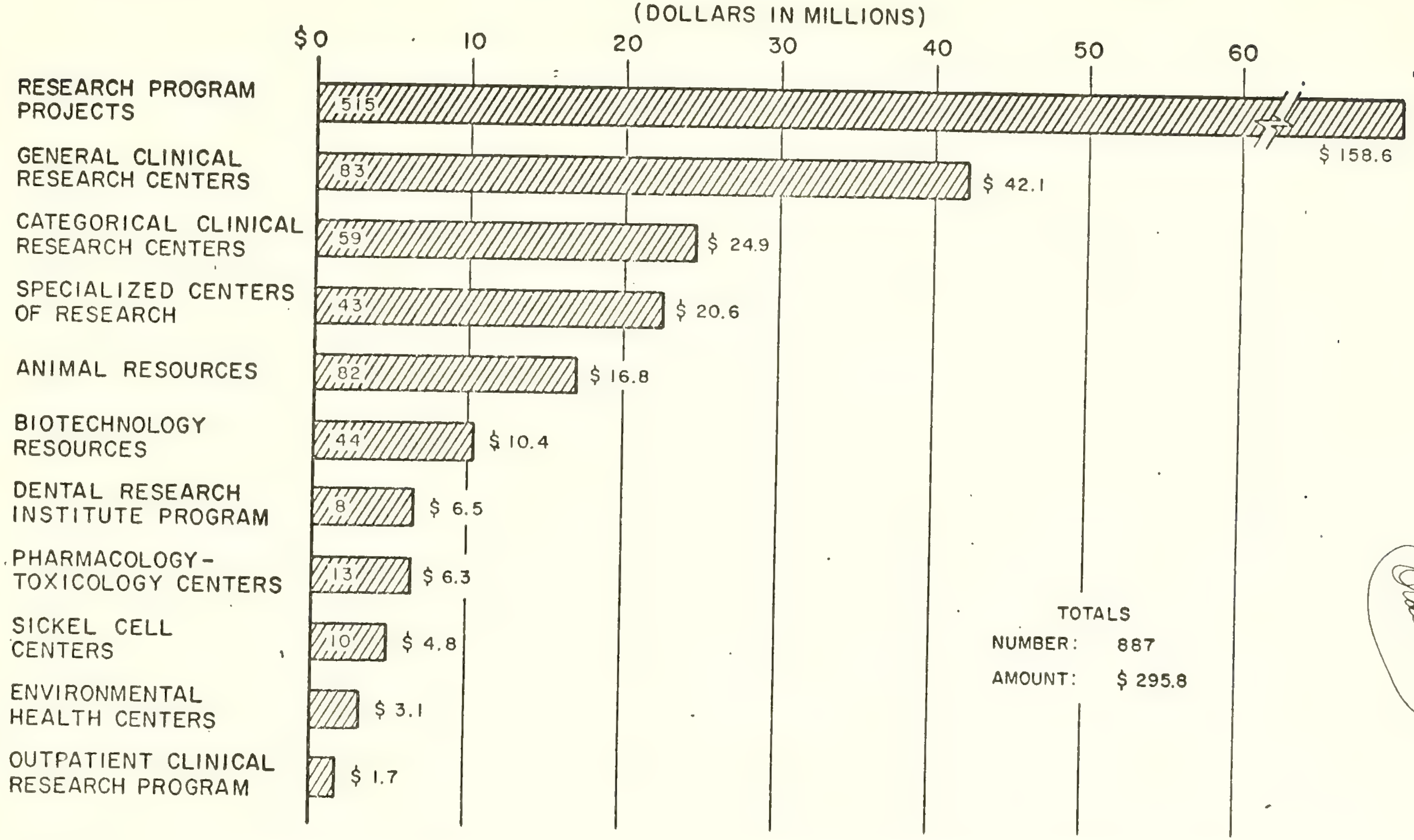
(DOLLARS IN MILLIONS)



*FY 1973 and 1974 from President's Budget of 2/16/73.

Order M 22

NIH RESEARCH PROGRAM-PROJECT AND CENTER GRANTS, BY TYPE OF GRANT, FY 1972*



Order M 2

*SUPPLEMENTS ARE NOT COUNTED IN NUMBERS OF GRANTS EXCEPT THOSE MADE FOR A PREVIOUS YEAR'S AWARD. AMOUNTS INCLUDE ALL SUPPLEMENTS.

Order M3

NIH RESEARCH PROGRAM PROJECTS AND CENTERS AS OF AUGUST 1972

(DOLLARS IN MILLIONS)

INSTITUTE	TYPE OF GRANT	NUMBER	AMOUNT
ALLERGY	PROGRAM PROJECTS	7	$ 2.4
	ALLERGIC DISEASE CENTERS	9	.6
	TRANSPLANTATION/IMMUNOLOGY CENTERS	3	.6
			$ 3.6
ARTHRITIS	PROGRAM PROJECTS	37	8.4
	CATEGORICAL CLINICAL CENTERS	10	2.2
			$ 10.6
CANCER	CLINICAL RESEARCH CENTERS	57	28.9
	PRECLINICAL RESEARCH CENTERS	26	19.7
	EXPLORATORY STUDIES FOR CENTERS	42	4.2
			$ 52.8
DENTAL	PROGRAM PROJECTS	19	4.7
	CATEGORICAL CLINICAL RESEARCH CENTER	1	.4
	DENTAL RESEARCH INSTITUTES	5	6.5
			$ 11.6
EYE	PROGRAM PROJECTS	10	3.3
	RESEARCH CENTERS	2	.3
	OUTPATIENT RESEARCH CENTERS	11	.7
			$ 4.3
ENVIRONMENTAL HEALTH	PROGRAM PROJECTS	12	3.7
	UNIVERSITY-BASED CENTERS	6	3.9
			$ 7.6

(CONTINUED)

M3

NIH RESEARCH PROGRAM PROJECTS AND CENTERS
AS OF AUGUST 1972 (DOLLARS IN MILLIONS) (CONT.)

INSTITUTE	TYPE OF GRANT	NUMBER	AMOUNT
GENERAL	PHARMACOLOGY/TOXICOLOGY P.P.	9	$ 2.0
MEDICAL	GENETICS & GENETIC CHEM. P.P.	14	5.9
SCIENCES	ANESTHESIOLOGY P.P.	2	.9
	DIAGNOSTIC RADIOLOGY P.P.	3	1.2
	AUTOMATED CLINICAL LABS P.P.	5	1.7
	CELLULAR BASIS OF DIS. P.P.	8	2.2
	BIOMEDICAL ENGINEERING P.P.	11	4.0
	ADAPTATION & BEHAVIOR P.P.	2	.7
	PHARMACOLOGY/TOXICOLOGY CENTERS	12	6.4
	GENETICS CENTERS	7	4.6
	ANESTHESIOLOGY CENTERS	4	3.2
	DIAGNOSTIC RADIOLOGY CENTERS	2	1.1
	TRAUMA CENTERS	8	2.4
			$ 36.3
CHILD	POPULATION RESEARCH PROGRAM PROJECTS	9	2.0
HEALTH	GROWTH AND DEVELOPMENT P.P.	11	2.2
	MENTAL RETARDATION PROGRAM PROJECTS	21	6.1
	PERINATAL BIO/INFANT MORTALITY P.P.	8	1.9
	CELL AGING PROGRAM PROJECTS	3	.7
	POPULATION RESEARCH CENTERS	5	1.3
	MENTAL RETARDATION CENTERS	12	5.6
			$ 19.8

(CONTINUED)

M3

NIH RESEARCH PROGRAM PROJECTS AND CENTERS
AS OF AUGUST 1972 (DOLLARS IN MILLIONS) (CONT.)

INSTITUTE	TYPE OF GRANT	NUMBER	AMOUNT
HEART	PROGRAM PROJECTS	76	$ 34.5
	SCOR--ARTERIOSCLEROSIS CENTERS	15	9.5
	SCOR--HYPERTENSION CENTERS	5	2.9
	SCOR--PULMONARY DISEASE CENTERS	17	5.5
	SCOR--THROMBOSIS CENTERS	5	1.6
	COMPREHENSIVE SICKLE CELL CENTERS	10	4.8
			$ 58.8
NEUROLOGY	GEN. NEURO. DISORDERS P.P.	8	1.7
	CHRONIC NEURO. DISORDERS P.P.	1	.1
	SENSORY AND PERCEPTUAL DISORDERS	7	1.4
	DISORDERS OF HEARING P.P.	5	1.5
	NERVE INJURY AND REGENERATION P.P.	2	.3
	GEN. NEURO. DISORDERS CENTERS	2	.5
	CEREBROVASCULAR DISORDERS CENTERS	15	4.0
	HEAD INJURY CLIN. RESEARCH CENTERS	5	.8
	ACUTE SP. CHORD INJURY CLIN. RES. CTRS.	6	.5
	CONVULSIVE DISORDERS CLIN. RES. CTRS.	3	1.1
	SENSORY, PERCEPTUAL DISORDERS CL. R. CTRS.	3	.7
	CHRONIC NEURO. DISORDERS CL. R. CTRS.	3	1.3
	DISORDERS OF HEARING CLIN. RES. CTRS.	1	.4
	OUTPATIENT CLIN. RES. CENTERS	4	.4
	MUSCULAR AND NEUROM. CLIN. RES. CTRS.	3	.9
			$ 15.6

(CONTINUED)

NIH RESEARCH PROGRAM PROJECTS AND CENTERS
AS OF AUGUST 1972 (DOLLARS IN MILLIONS) (CONT.)

INSTITUTE	TYPE OF GRANT	NUMBER	AMOUNT
RESEARCH RESOURCES	BIOTECHNOLOGY RESOURCE CENTERS	40	$ 10.4
	PRIMATE RESEARCH CENTERS	7	11.2
	ANIMAL COLONIES, ANIMAL MODEL DEV.	29	2.1
	ANIMAL RESOURCE DIAGNOSTIC LABS.	16	1.1
	INST. ANIMAL RESOURCE IMPROVEMENT	23	2.1
	GENERAL CLINICAL RESEARCH CENTERS	83	42.2
			$ 69.1

M3

COMPETING NEW AND RENEWAL APPLICATIONS FOR NIH RESEARCH-PROJECT AND PROGRAM-PROJECT AND CENTER GRANTS, FY 1967-1972

TYPE OF GRANT	1967	1968	1969	1970	1971	1972
RESEARCH PROJECTS	100 N = 8,084	93.3	95.1	95.5	96.5	109.6
PROGRAM PROJECTS & CENTERS	100 N = 233	101.3	127.5	111.2	148.1	216.3

Order M7

Order M6

NUMBER OF COMPETING NIH GRANTS FOR REGULAR RESEARCH PROJECTS AND PROGRAM-PROJECTS AND CENTERS, FY 1967-1972*

TYPE OF GRANT	1967	1968	1969	1970	1971	1972
RESEARCH PROJECTS	100 N=3,927	76.8	82.8	64.2	67.9	90.8
NEW	100 N=2,210	67.6	77.4	52.5	64.2	91.9
RENEWALS	100 N=1,717	88.6	89.7	79.3	72.7	89.3
PROGRAM PROJECTS & CENTERS	100 N=141	105.7	139.7	116.3	148.2	197.9
NEW	100 N=99	81.8	90.0	47.5	106.1	162.6
RENEWALS	100 N=42	157.1	257.1	278.6	247.6	281.0

*EXCLUDES SUPPLEMENTAL AND CONTINUATION AWARDS.

SCIENTIFIC REVIEW OF PROGRAM-PROJECT AND CENTER GRANTS, 1972

Oider M9

RESPONSIBILITY FOR INITIAL SCIENTIFIC REVIEW	
DIV. OF RES. GRANTS	14
AWARDING INSTITUTE	31
FREQUENCY OF SCIENTIFIC REVIEW	
ANNUALLY (INTERIM REVIEW)	40
BIENNIALLY (INTERIM REVIEW)	1
FOR CONTINUATION AWARDS ONLY—	38
AT END OF THIRD YEAR	11
AT END OF FOURTH YEAR	27

CENTER GRANT PROGRAMS WITH BUDGET "LINES"

Order M8

- NCI — CLINICAL + PRECLINICAL + EXPLORATORY = 1 (P02 + P01)
- NHLI — SCOR (P17) = 1
- NICHD — MENTAL RETARDATION CENTERS = 1
- NIDR — CENTERS (P02) + INSTITUTES (P13) = 2
- NIEHS — CENTERS (P10) = 1
- NIGMS — CENTERS: PHARM-TOX (P11), ANESTH. (P01), RADIOL. (P01) = 3

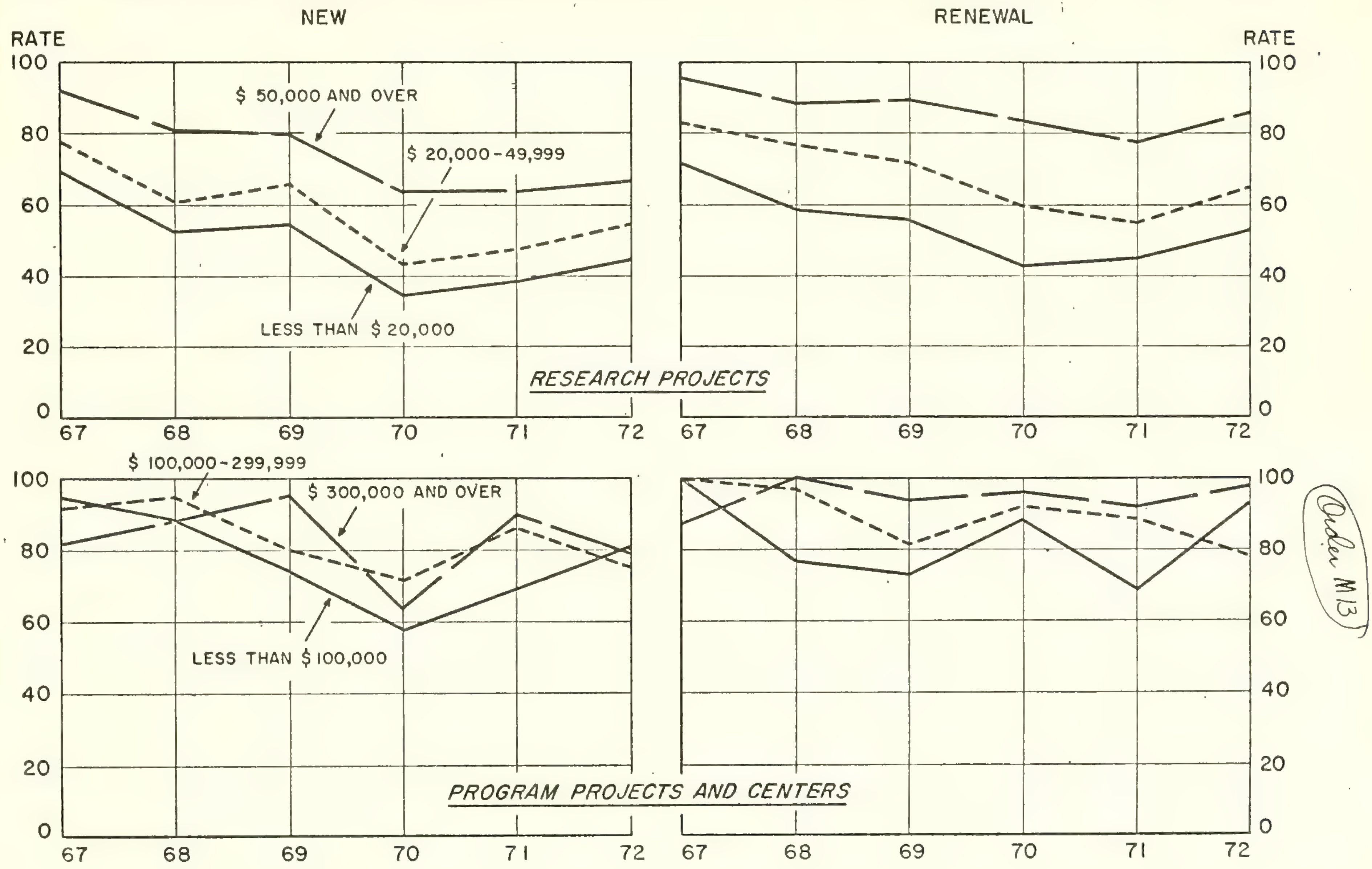
Order M10

ALLOWABLE SUPPORT UNDER NIH PROGRAM-PROJECT AND CENTER GRANTS, 1972

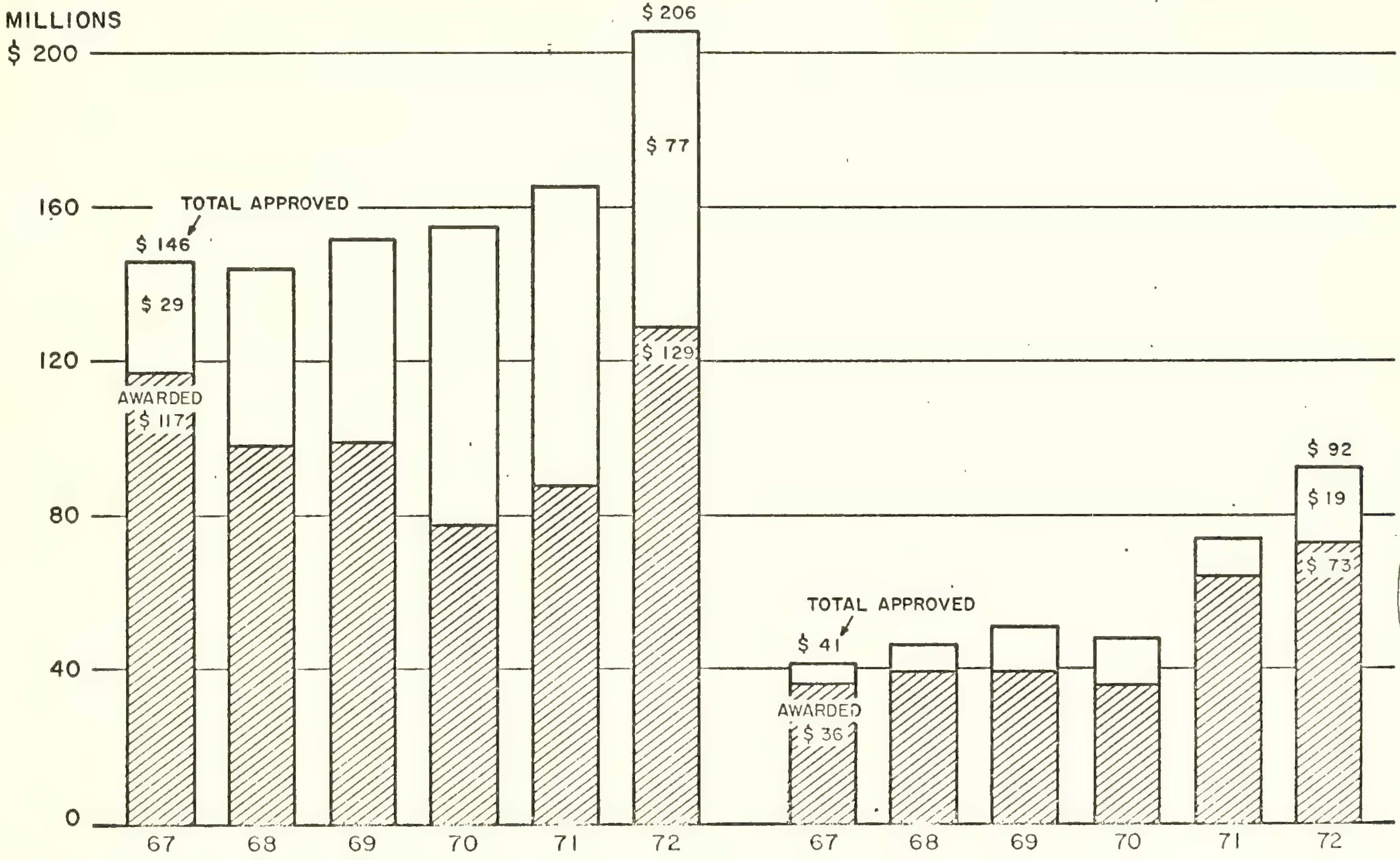
$ For—	Not allowed	Allowed	Encouraged	Required
Core*	5	20	15	5
Projects	5	14	5	17
Admin. staff	-	30	8	3
Research staff	3	12	8	21
Space	4	19	7	4
Beds	9	30	2	3
Res. training	40	-	4	-
Clin. training	40	-	2	-
Fees + subcontracts	9	34	1	-

*No program-project grants.

AWARD RATES OF NIH NEW AND RENEWAL GRANTS FOR RESEARCH PROJECTS AND PROGRAM-PROJECTS AND CENTERS, BY DOLLAR-AWARD INTERVALS, FY 1967-1972



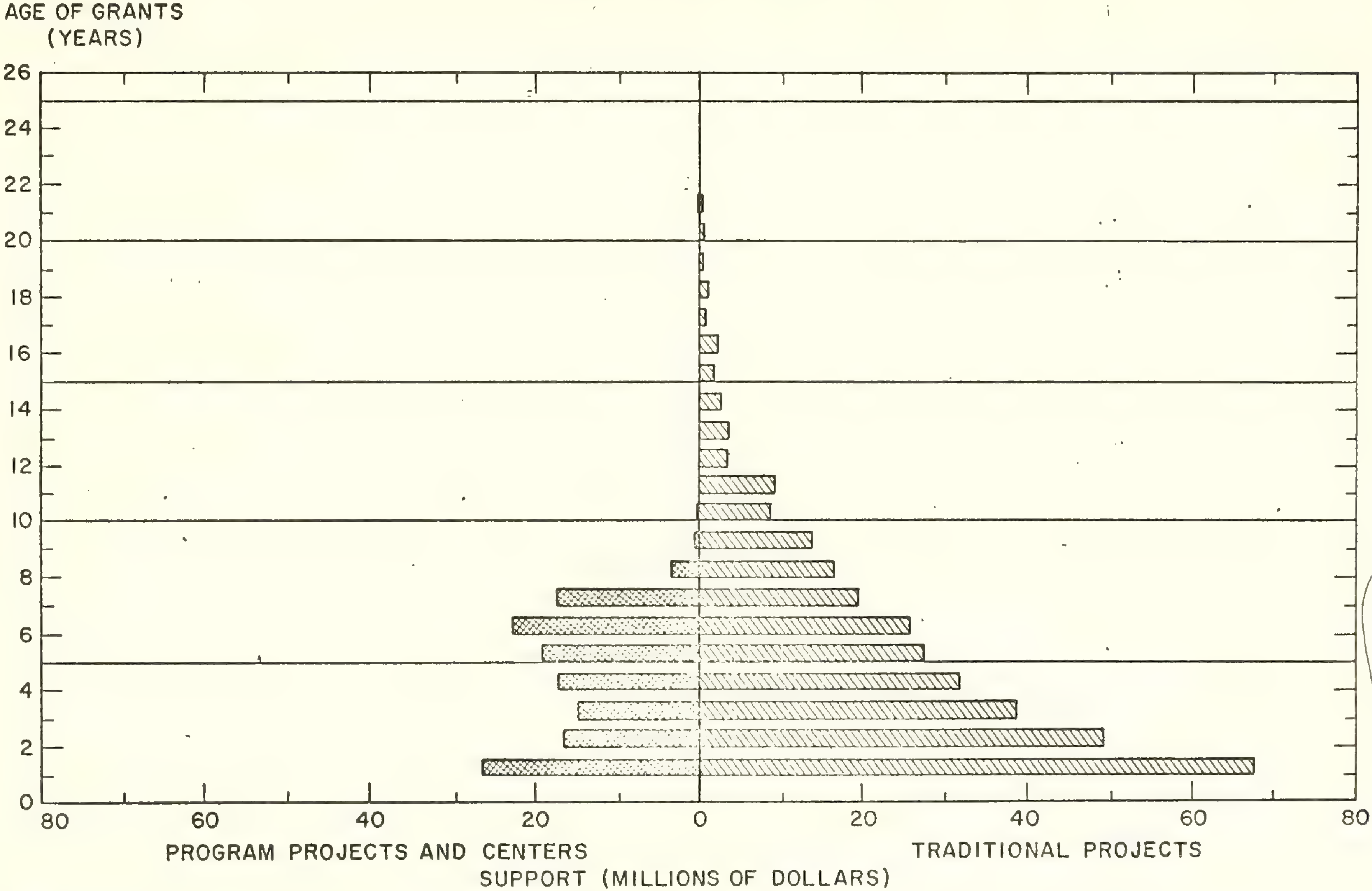
NIH RESEARCH PROJECT AND PROGRAM-PROJECT AND CENTER GRANTS APPROVED BY COUNCILS AND AWARDED, FY 1967-1972*



*INCLUDES DIRECT COSTS, COMPETING APPLICATIONS ONLY.

Order M14

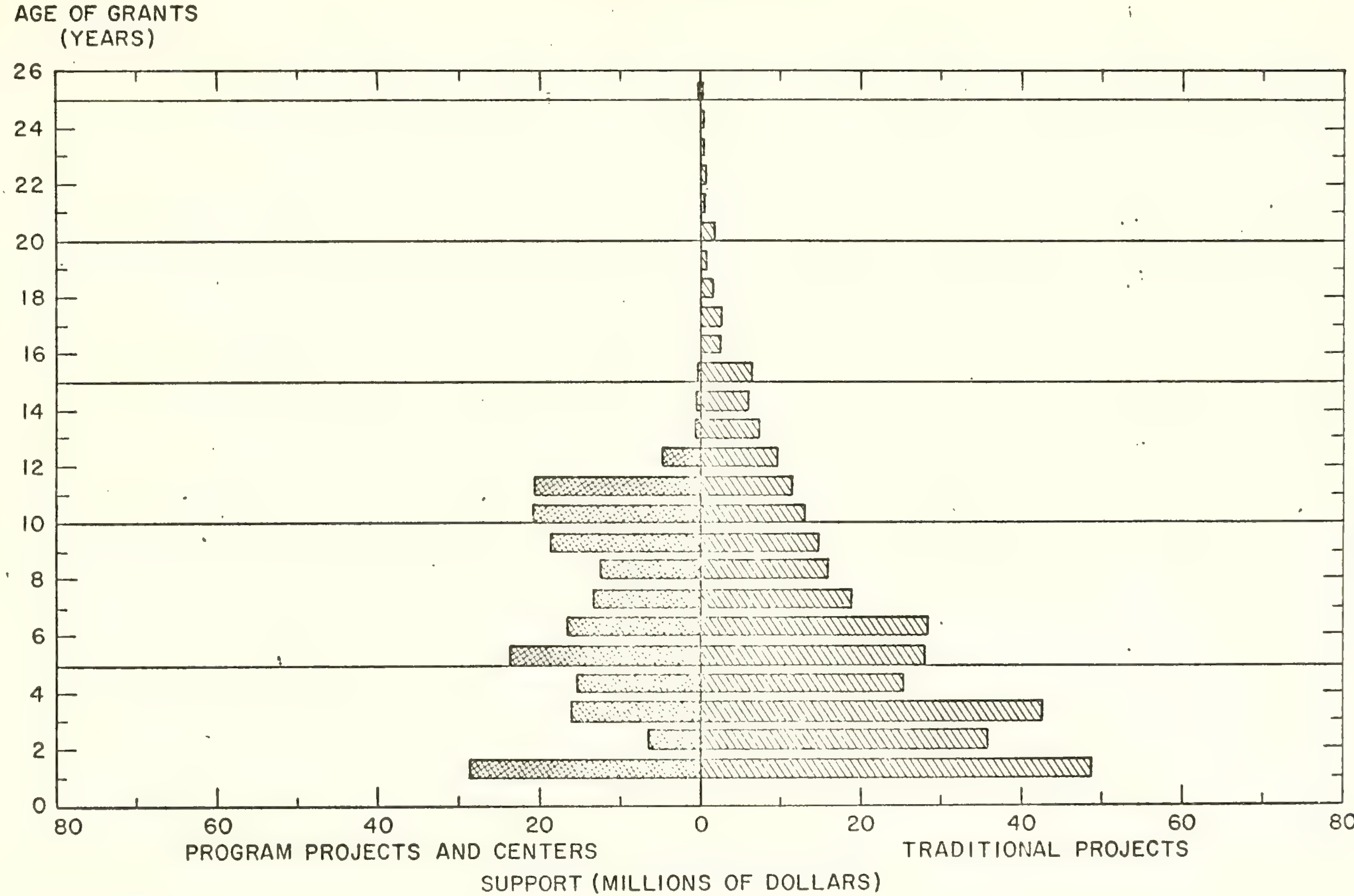
DISTRIBUTION OF NIH RESEARCH GRANT FUNDS BY PROGRAM AND AGE OF GRANT, FISCAL YEAR 1967*



Order M11

* EXCLUDING NCI

DISTRIBUTION OF NIH RESEARCH GRANT FUNDS BY PROGRAM AND AGE OF GRANT, FISCAL YEAR 1971*



*EXCLUDING NCI

Order M12

Order M23

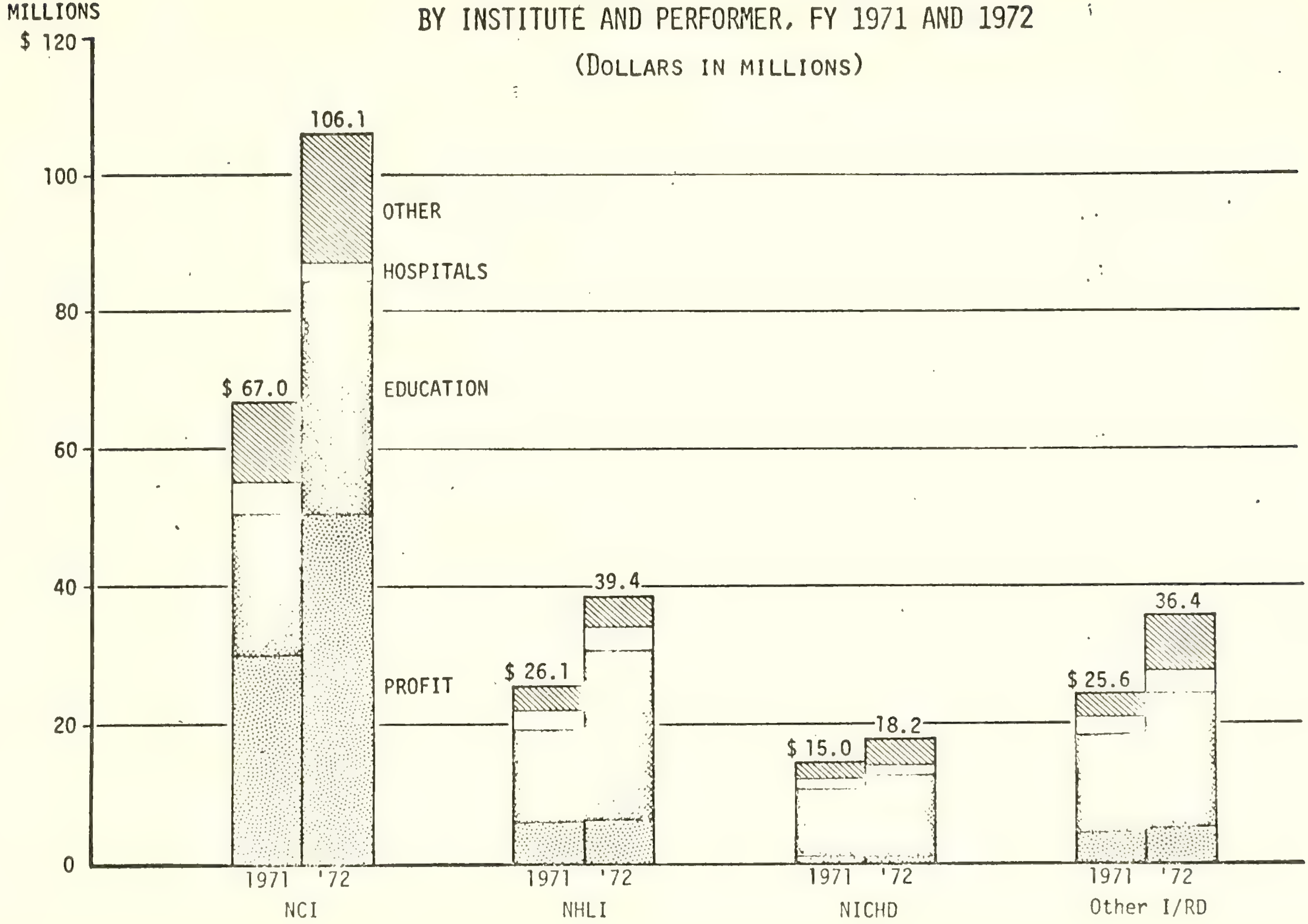
NIH FUNDS OBLIGATED FOR SELECTED "TARGETED" PROGRAMS, FY 1973

(IN THOUSANDS OF DOLLARS)

Institute	Program	Contracts	Other	Total
NCI	Cancer Chemotherapy	$40,555	$16,508	$57,063
	Special Virus Cancer	42,204	6,855	49,059
	Chemical Carcinogenesis	22,649	3,584	26,233
	Cancer Task Forces	12,371	4,661	17,032
NHLI	Arteriosclerosis	25,457	68,124	93,581
	Heart Co-op. Drug	500	4,900	5,400
	Sickle Cell Disease	5,761	9,239	15,000
	Medical Devices	11,572	600	12,172
NIDR	Dental Caries	3,559	5,138	8,697
NIAMDD	Artificial Kidney/ Chronic Uremia	4,319	601	4,920
NINDS	Collaborative Perinatal	3,500	1,926	5,426
NIAID	Interferon/Antiviral	900	5,504	6,404
	Immunoprophylaxis	3,000	3,165	6,165
NICHD	Population Research	15,009	24,835	39,844
	TOTAL	$191,356	$155,640	$346,996

FUNDS AWARDED IN NIH RESEARCH CONTRACTS, BY INSTITUTE AND PERFORMER, FY 1971 AND 1972

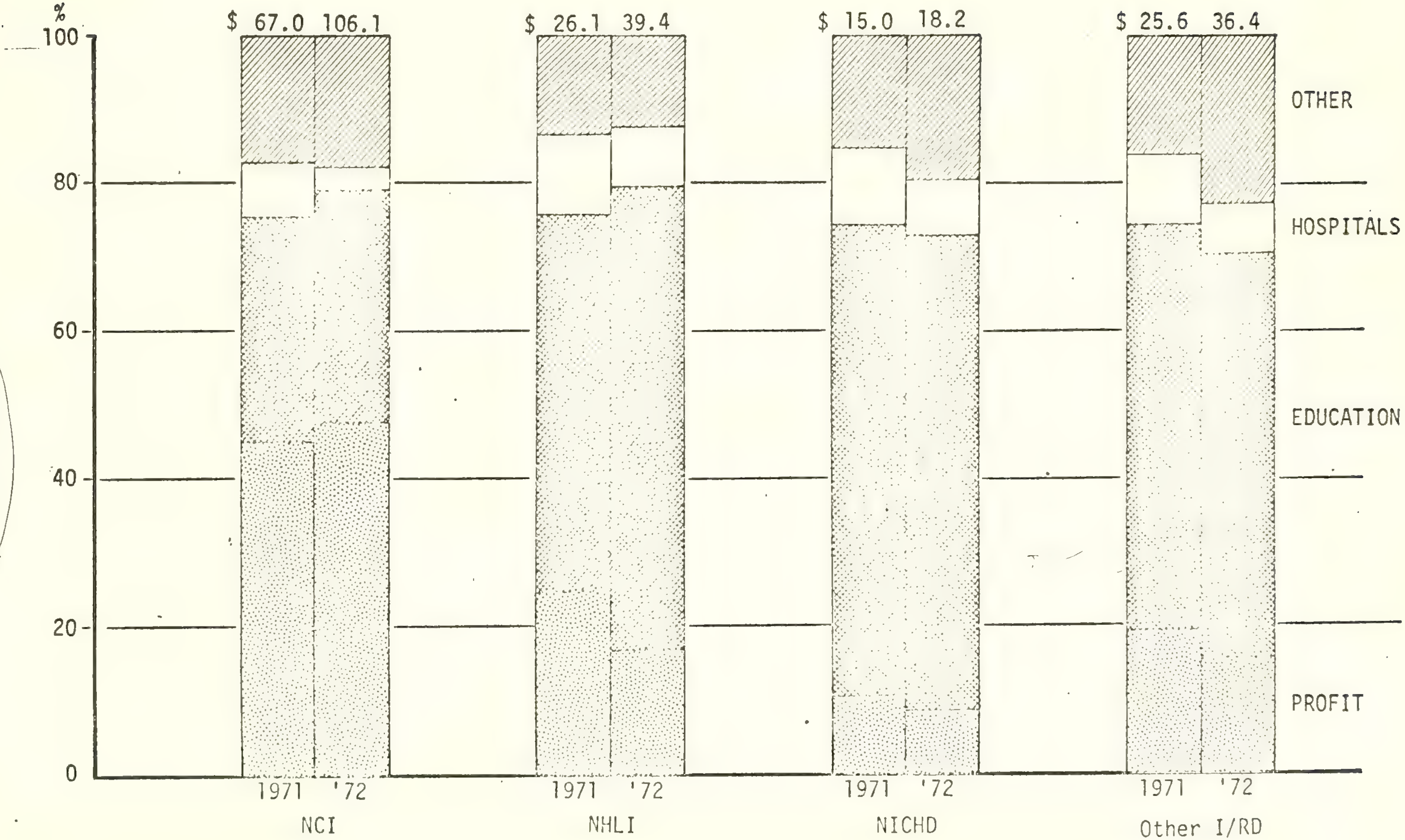
(DOLLARS IN MILLIONS)



Order M24

PERCENTAGE DISTRIBUTION OF FUNDS AWARDED
IN NIH RESEARCH CONTRACTS, BY INSTITUTE AND PERFORMER,
FY 1971 AND 1972

(DOLLARS IN MILLIONS)



Order - M25

TAB 14

AN EXPERIMENTAL ALTERNATIVE TO PROGRAM PROJECT AND CENTER GRANTS

In the last decade or so, and particularly in the last five years, the *absolute level* of investment in program project and center grants has increased substantially and, in at least three institutes (NCI, NHLI, and NICHD), the *fraction* of the institutes' budget devoted to the support of research through these instrumentalities has increased significantly.

Very substantial advantages and advances can be attributed to the introduction of this administrative innovation. After a decade of solid experience, the NIH has been in the process of reviewing the effectiveness of these mechanisms of support. The institutes view them as extremely valuable and powerful tools in achieving their categorical missions, and grantee institutions also appear to regard them as very useful. On the other hand, some problems have emerged for both the NIH and the grantees.

The Problem

In the grantee institutions, difficulty has been experienced in exerting administrative surveillance over very large-scale activities as well as in reconciling the activities and personnel supported under the grant with the overall short- and long-term objectives of the institution. From the point of view of the NIH, the central problem has been to insure a quality review of large and complicated proposals, consisting of many projects under the guidance of many investigators.

Since these proposal are frequently characterized by a broad spread in the imaginativeness of component parts and in the competence of individual investigators, the assigned priority score is a composite of many elements and thus is difficult to interpret. Moreover, the nature of the aggregated proposal characteristically dictates the need for long-term support, so that new projects and new investigators - not examined during the initial review - frequently begin to work under the grant after its initiation. Thus, monitoring these awards is an essential but increasingly difficult task, as in-house NIH employment ceilings are progressively reduced.

The Question

Would a proposal along the following lines preserve the best features of, and improve on the deficiencies in, program project/center grants?

1. Let the initiative for the creation of a program come from principal investigators with project support when they see merit in integrating their projects into a coherent unit.
2. The signal of this consensus would be the submission of a request for core support which, by specified activities, facilitate the integration of the already funded projects. (This is not very different from Dr. Ames' general categorical support grant.)

3. The appropriate institute could negotiate the amount of core support and add to it, where appropriate, contract support for necessary activities more appropriately supported by the latter mechanism.

4. The core support could be expected to increase as the size and complexity of the effort expands, a process fundamentally achieved by an increase in the number of projects in the program.

Putative Advantages

The main advantage that would accrue to grantee institutions is that the bulk of major programs would be built upon existing research efforts; the distortion associated with major efforts, the bulk of which are new, is avoided.

The major virtue as far as the NIH is concerned is that traditional study section review--in a style known to yield high quality evaluations--will operate. All major elements of a program will have passed muster and no significant new element will be addable without such review. Thus, both the NIH and the scientific community will gain a new respect for the research program blanketed in under the awards. At the same time, a high degree of ideological purity will have been maintained, with the proper instrument (grant or contract) being used in the most appropriate context.

NIH staff may more effectively facilitate achievement of categorical missions through negotiations regarding such elements as: what projects

may properly be included; what activities are to be supported at what level of intensity under a core grant; what contract support might be appropriate, etc.

Possible Disadvantages

The clear price for adopting this mechanism of support is an increase in the administrative and managerial load on the grantee institutions and especially on the staff of, and the advisors to, the NIH. Other probable losses: the program building potential of present program project and center grants. Likelihood of achieving "critical mass" on particular problem is substantially reduced because only those individuals who can meet national competition could be included. Also, where is the incentive for anyone to apply for one of these "core" grants? (Many scientists would prefer to do their own thing rather than to cooperate unless there are big, clear benefits from their perspective).

A Modest Proposal

Set up a pilot study in one or two institutes involving: a *de novo* effort that would otherwise have been operated as a program project or center grant program; and the conversion of an existing program project or center grant program to the proposed *modus operandi*. Some criteria for success should be established *a priori* and appropriate measurements taken throughout to attempt to demonstrate advantage in the changes. However, it should be recognized that the only palapable difference may be the degree of anxiety about quality felt by the government and academic participants.

TAB 15

#719

MEMO FOR THE RECORD:

The attached material was used by Dr. Thomas J. Kennedy, Jr. at the Intercouncil meeting on 1/29/74. (Material arranged in the order it was presented.)

SEE ATTACHED

A COUNT OF PUBLICATIONS BY 14 BIOMEDICAL NOBELISTS, 1972-73, -DERIVED FROM NLM'S MEDLINE, 1/24/74

	1972	1973	Total
Anfinsen	6	6	12
Axelrod	19	11	30
Delbruck	0	1	1
Edelman	8	6	14
Hershey	0	0	0
Holley	4	0	4
Khorana	22	2	24
Luria	2	0	2
Moore	6	6	12
Nirenberg	4	3	7
Porter	2	1	3
Stein	0	4	4
Sutherland	2	3	5
Von Euler	3	0	3
Total	78	43	121

1

PUBLICATIONS OF C. B. ANFINSON, 1973

Furie, B., Eastlake, A., Schechter, A. N. and Anfinsen, C. B.: The interaction of the lanthanide ions with staphylococcal nuclease. J. Biol. Chem., 248: 2821-5, Aug. 25, 1973.

Anfinsen, C. B.: Principles that govern the folding of protein chains. Science, 181: 223-30, July 20, 1973.

Dunn, B. M., Dibello, C. and Anfinsen, C. B.: The pH dependence of the steady state kinetic parameters for staphylococcal nuclease-catalyzed hydrolysis of deoxythymidine-3'-phosphate-5'-p-nitrophenylphosphate in H 2 O and D 2 O. J. Biol. Chem., 248: 4769-74, July 10, 1973.

Sanchez, G. R., Chaiken, I. M. and Anfinsen, C. B.: Structure-function relationships at the active site of nuclease-t'. J. Biol. Chem., 248: 3653-9, May 25, 1973.

Fisher, W. R., Taniuchi, H. and Anfinsen, C. B.: On the role of heme in the formation of the structure of cytochrome C. J. Biol. Chem., 248: 3188-95, May 10, 1973.

Fuchs, S., Sela, M. and Anfinsen, C. B.: Nuclease-coated bacteriophage: a sensitive tool for studying antigenic reactivity of synthetic sequence fragments. Arch. Biochem. Biophys., 154: 601-5, Feb. 1973.

PUBLICATIONS OF J. AXELROD, 1973

Saavedra, J. M., Brownstein, M. and Axelrod, J. : A specific and sensitive enzymatic-isotopic microassay for serotonin in tissues. J. Pharmacol. Exp. Ther., 186: 508-15, Sept. 1973.

Ciaranello, R. D. and Axelrod, J.: Genetically controlled alterations in the rate of degradation of phenylethanolamine N-methyltransferase. J. Biol. Chem., 248: 5616-23, Aug. 25, 1973.

Brownstein, M., Holz, R. and Axelrod, J.: The regulation of pineal serotonin by a beta adrenergic receptor. J. Pharmacol. Exp. Ther., 186: 109-13, July 1973.

Saavedra, J. M. and Axelrod, J.: Demonstration and distribution of phenylethanolamine in brain and other tissues. Proc. Natl. Acad. Sci., 70: 769-72, March 1973.

Wyatt, R. J., Saavedra, J. M. and Axelrod, J.: A dimethyltryptamine-forming enzyme in human blood. Am. J. Psychiatry, 130: 754-60, July 1973.

Saavedra, J. M. and Axelrod, J.: Effect of drugs on the tryptamine content of rat tissues. J. Pharmacol. Exp. Ther., 185: 523-9, June 1973.

Wooten, G. F., Thoa, N. B., Kopin, I. J. and Axelrod, J.: Enhanced release of dopamine-hydroxylase and norepinephrine from sympathetic nerves by dibutyryl cyclic adenosine 3', 5'-monophosphate and theophylline. Mol. Pharmacol., 9: 178-83, March 1973.

Ciaranello, R. D., Jacobowitz, D. and Axelrod, J.: Effect of dexamethasone on phenylethanolamine N-methyltransferrase in chromaffin tissue of the neonatal rat. J. Neurochem., 20: 799-805, March 1973.

Saavedra, J. M., Coyle, J. T. and Axelrod, J.: The distribution and properties of the nonspecific N-methyltransferase in brain. J. Neurochem., 20: 743-52, March 1973.

Axelrod, J.: Nobel prize winner talks about noradrenaline, nerves and aging. Geriatrics, 28: 42 passim, March 1973.

Kreuz, D. S. and Axelrod, J.: Delta-9-tetrahydrocannabinol: localization in body fat. Science, 179: 391-3, Jan. 26, 1973.

PUBLICATIONS OF M. DELBRUCK, 1973

Ootaki, T., Lighty, A. C., Delbruck, M. and Hsu, W. J.: Complementation between mutants of phycomyces deficient with respect to carotenogenesis. Mol. Gen. Genet., 121: 57-70, 1973.

PUBLICATIONS OF G.M. EDELMAN, 1973

Spear, P.G., Wang, A.L., Rutishauser, U. and Edelman, G.M.: Characterization of splenic lymphoid cells in fetal and newborn mice. J. Exp. Med., 138: 557, Sept. 1, 1973.

Gunther, G.R., Wang, J.L., Yahara, I., Cunningham, B.A. and Edelman, G.M.: Concanavalin A derivatives with altered biological activities. Proc. Natl. Acad. Sci., 70: 1012-1016, April 1973.

Edelman, G.M.: Receptor biophysics and biochemistry. The immune system. Neurosci. Res. Program Bull., 11: 176-183, June 1973.

Edelman, G.M., Yahara, I. and Wang, J.L.: Receptor mobility and receptor-cytoplasmic interactions in lymphocytes. Proc. Natl. Acad. Sci., 70: 1442-1446, May 1973.

Edelman, G.M.: Antibody structure and molecular immunology. Science, 180: 830-840, May 25, 1973.

Edelman, G.M. and Moller, G.: The immune system as a model for cellular maturation and differentiation. Neurosci. Res. Program Bull., 11: 1-154, March 1973.

PUBLICATIONS OF H.G. KHORANA, 1973

Cashion, P.J., Fridkin, M., Agarwal, K.L., Jay, E. and Khorana, H.G.: Use of trityl- and -naphthylcarbamoylcellulose derivatives in oligonucleotide synthesis. Biochemistry, 12: 1985-1990, May 8, 1973.

Loewen, P.C. and Khorana, H.G.: Studies on polynucleotides. CXXII. The dodecanucleotide sequence adjoining the C-C-A end of the tyrosine transfer ribonucleic acid gene. J. Biol. Chem., 248: 3489-3499, May 25, 1973.

PUBLICATIONS OF S. MOORE, 1973

Hugli, T.E., Bustin, M., Moore, S.: Spectrophotometric assay of 2',3'-cyclic nucleotide 3'-phosphohydrolase: Application of the enzyme in bovine brain. Brain Res., 58: 191-203, Aug. 17, 1973.

Hayashi, R., Moore, S., Merrifield, R.B.: Preparation of pancreatic ribonucleases 1-114 and 1-115 and their reactivation by mixture and synthetic COOH-terminal peptides. J. Biol. Chem., 248: 3889-92, June 10, 1973.

Moore, S., Stein, W.H.: Chemical structures of pancreatic ribonuclease and deoxyribonuclease. Science, 180: 458-64, May 4, 1973.

Hayashi, R., Moore, S., Stein, W.H.: Carboxypeptidase from yeast. Large scale preparation and the application to COOH-terminal analysis of peptides and proteins. J. Biol. Chem., 248: 2296-302, Apr. 10, 1973.

Liao, T.H., Salnikow, J., Moore, S., Stein, W.H.: Bovine pancreatic deoxyribonuclease A. isolation of cyanogen bromide peptides; complete covalent structure of the polypeptide chain. J. Biol. Chem., 248: 1489-95, Feb. 25, 1973.

Salnikow, J., Liao, T.H., Moore, S., Stein, W.H.: Bovine pancreatic deoxyribonuclease A. isolation, composition, and amino acid sequences of the tryptic and chymotryptic peptides. J. Biol. Chem., 248: 1480-8, Feb. 25, 1973.

PUBLICATIONS OF M.W. NIRENBERG, 1973

Thompson, E.J., Wilson, S.H., Schuette, W.H., Whitehouse, W.C., Nirenberg, M.W.: Measurement of the rate and velocity of movement by single heart cells in culture. Am. J. Cardiol., 32: 162-6, Aug. 1973.

Greene, L.A., Sytkowski, A.J., Vogel, Z., Nirenberg, M.W.: Bungarotoxin used as a probe for acetylcholine receptors of cultured neurones. Nature, 243: 163-6, May 18, 1973.

Sytkowski, A.J., Vogel, Z., Nirenberg, M.W.: Development of acetyloholine receptor clusters on cultured muscle cells. Proc. Natl. Acad. Sci., 70: 270-4, Jan. 1973.

PUBLICATIONS OF R.R. PORTER, 1973

Porter, R.R.: Structural studies of immunoglobulins. Science, 180: 713-6, May 1973.

6

PUBLICATIONS OF W.H. STEIN, 1973

Moore, S. and Stein, W.H.: Chemical structures of pancreatic ribonuclease and deoxyribonuclease. Science, 180: 458-464, May 4, 1973.

Hayashi, R., Moore, S. and Stein, W.H.: Carboxypeptidase from yeast. Large scale preparation and the application to COOH-terminal analysis of peptides and proteins. J. Biol. Chem., 248: 2296-2302, April 10, 1973.

Liao, T.H., Salnikow, J., Moore, S. and Stein, W.H.: Bovine pancreatic deoxyribonuclease A. isolation of cyanogen bromide peptides; complete covalent structure of the polypeptide chain. J. Biol. Chem., 248: 1489-1495, February 25, 1973.

Salnikow, J., Liao, T.H., Moore, S. and Stein, W.H.: Bovine pancreatic deoxyribonuclease A. isolation, composition, and amino acid sequences of the tryptic and chymotryptic peptides. J. Biol. Chem., 248: 1480-1488, February 25, 1973.

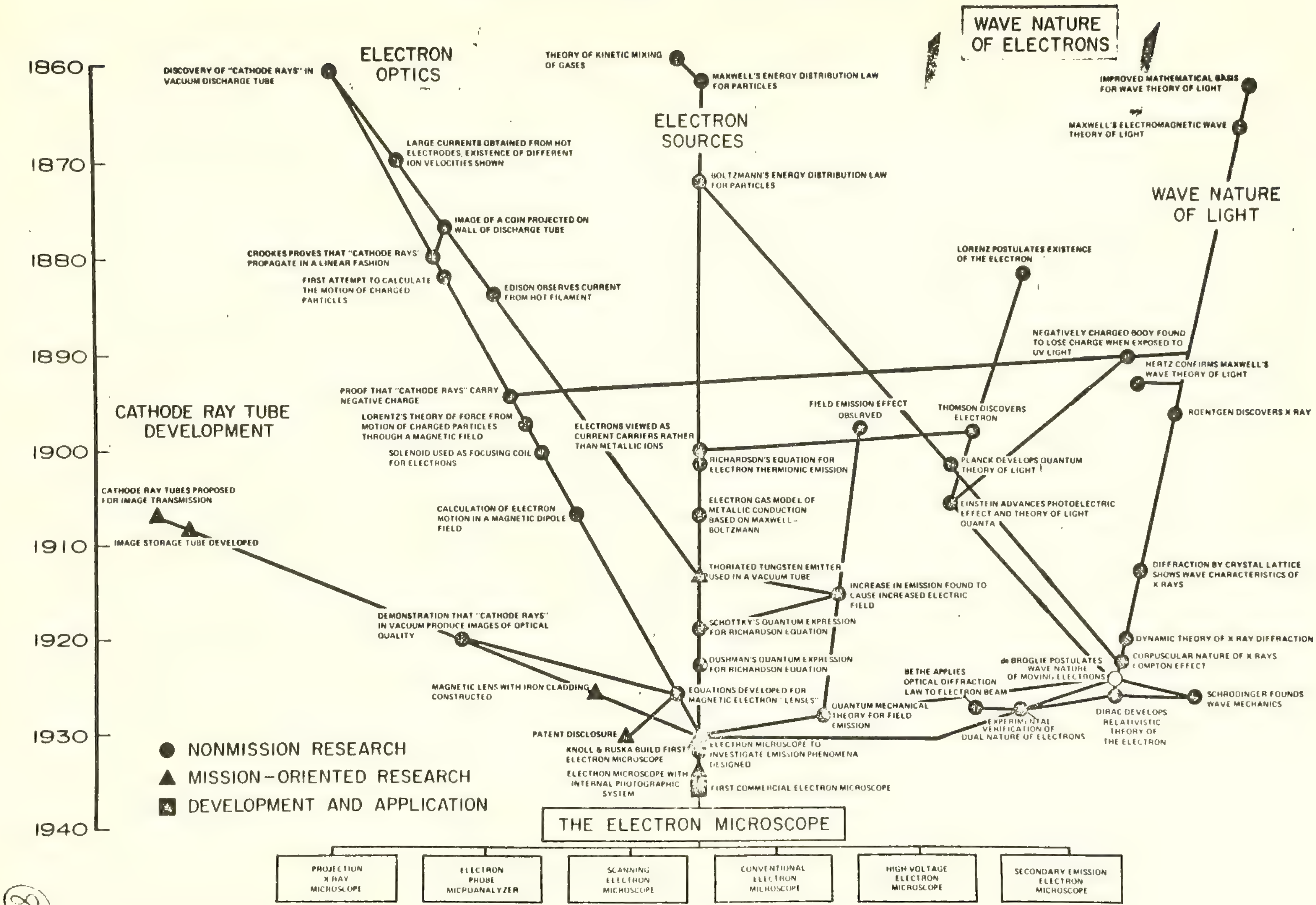
PUBLICATIONS OF E.W. SUTHERLAND, 1973

Schultz, G., Hardman, J.G., Schultz, K., Davis, J.W. and Sutherland, E.W.: A new enzymatic assay for guanosine 3':5'-cyclic monophosphate and its application to the ductus deferens of the rat. Proc. Natl. Acad. Sci., 70: 1721-1725, June 1973.

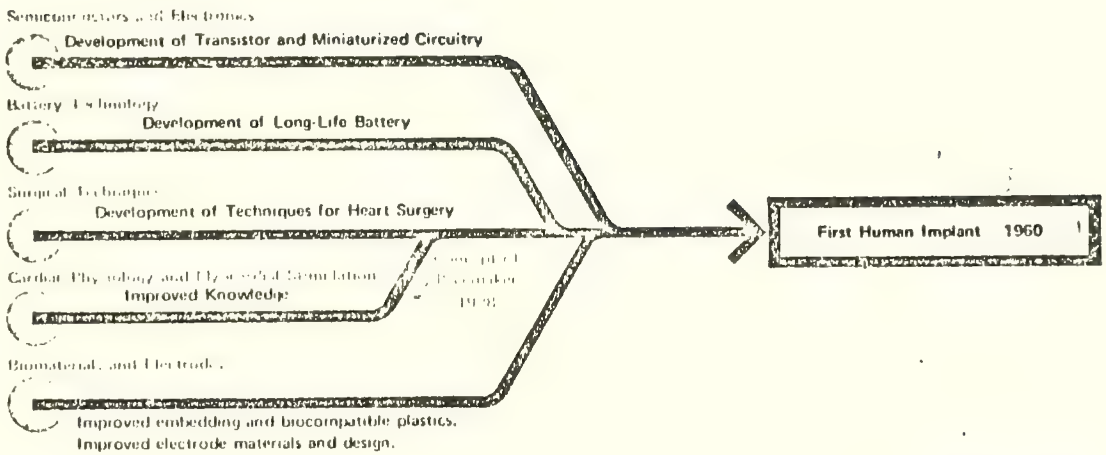
Johnson, R.A. and Sutherland, E.W.: Detergent-dispersed adenylate cyclase from rat brain. Effects of fluoride, cations, and chelators. J. Biol. Chem., 248: 5114-5121, July 25, 1973.

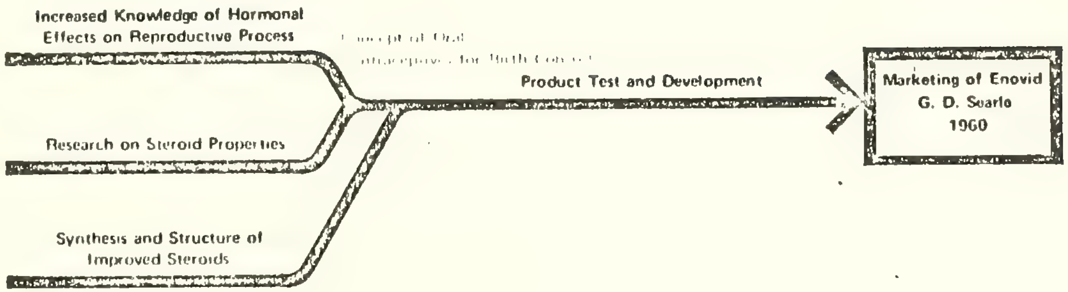
Peytremann, A., Nicholson, W.E., Liddle, G.W., Hardman, J.G. and Sutherland, E.W.: Effects of methylxanthines on adenosine 3',5'-monophosphate and corticosterone in the rat adrenal. Endocrinology, 92: 525-530, February 1973.

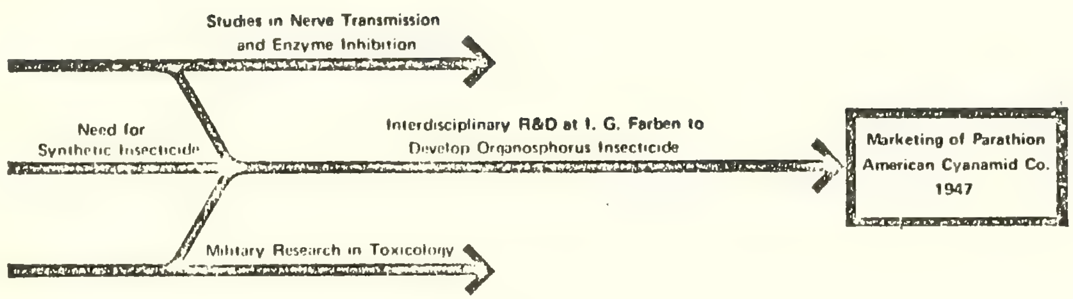
THE ELECTRON MICROSCOPE



THE HEART PACEMAKER




Increased Knowledge of Hormonal
Effects on Reproductive Process
Research on Steroid Properties
Synthesis and Structure of
Improved Steroids
Product Test and Development
Marketing of Enovid
G. D. Searle
1960


Studies in Nerve Transmission
and Enzyme Inhibition
Need for
Synthetic Insecticide
Interdisciplinary R&D at I. G. Farben to
Develop Organosphorus Insecticide
Military Research in Toxicology
Marketing of Parathion
American Cyanamid Co.
1947

11

TAB 16

#734

Status of Funding of NIH/NIMH Sponsored Research*

Thomas Kennedy, M.D.

When Drs. Sherman and Morgan asked me earlier this month to address today's meeting, I agreed with what now appears to have been unseemly haste. Liberated from Federal employment, I was chomping at the bit to exercise my new freedom and to speak my mind. Alas and alack, I had forgotten one important concomitant of retirement: I no longer had at my disposal that splendid well oiled machine of professionals in the front office at the NIH that has been so effective in the selection, collection, analysis and interpretation of data. I thus appear before you this afternoon as one in a superb position to say a great deal about very little. Under these circumstances, preparing this talk has been most instructive for me, specifically in respect to three considerations: perspective, data and analyses. I should like to amplify on these aspects later if time permits. And fortunately, I was able to persuade my former colleagues at the NIH to give me a hand, despite their preoccupation with pulling together data for their own presentation today to the Presidents Panel.

The first slide depicts NIH research expenditures since FY 1960. The total height of each bar is in current dollars; the solid component is in constant dollars while the clear part reflects the loss to inflation. For the budget watchers in the crowd, the biomedical research deflator used was recently developed under the auspices of the NIH; it is slightly different from, and more realistic than, the overall GNS implicit price deflator.

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*Presented before the Spring Meeting, Council of Academic Societies, Association of American Medical Colleges (AAMC), March 31, 1975.

It can be seen that the total research budget grew apace until FY 1968, then experienced a couple of bad years, and later resumed its upward trend. In point of fact, the total obligations projected for FY 1975 are just short of double the prior peak level of FY 1968.

However, if one asks the question: "how much more research has the NIH been able to buy?", the answer is considerably less than twice as much. By comparing the heights of the solid bars in FYs 1968 and 1975, it may be seen that the increase in real dollars over that period is only about 35%. In terms of resources available at the bench and at the bedside, it should be recalled that indirect costs rates on research project, program project and center grants have been rising, so that a shrinking fraction of the total award is available for the actual research. The second slide depicts the rising indirect cost rates since 1967, slightly higher for regular research project than for program projects and center grants, but on the average increasing from 18.6% to 31.7% of direct costs. Restated somewhat differently: while direct research costs have increased about 65%, indirect costs have risen by about 180%. Thus, the funds actually available to the scientist for research were overstated by the heights of the solid bars in the first slide. The indirect cost increases either have purchased new support services for research -- better accounting records, better management, better central services --, or have reflected an entirely appropriate transfer to the Federal sponsor of costs previously borne by the institution. But in either case the funds available for direct research have been reduced.

When the effect of inflation and indirect costs are taken into consideration, the growth in resources for research itself are indeed small.

Aggregated data is of limited usefulness. Let me disaggregate in several different ways. The third slide is a summary derived by selecting every fifth

year, and about a third of the budget category items from a larger table of NIH expenditures that I hope will be available to you after this talk or in its published version. In this slide, some of the components of the bar graph shown a moment ago are looked at separately. When intramural and administrative costs are subtracted from the total budget, the remainder defines the total extramural program. Most of this is research, whether grant or contract. However, from 15-30% -- or in FY 1975, a little more than $200 million -- will be allocated to support training and (cancer) construction. Budget watchers have traditionally liked to track the flow of these funds into academic institutions in general and into medical schools in particular; accordingly, cognate data have been included in the table. It is quite hazardous, at least in principle, to estimate distributions by class of institutions before study section and council decisions have been made, and so data for the lower cells on the right are not available for FY 1975; the FY 1974 value for total academic science was $1, 214 million and for medical school academic science $913 million.

Comparisions are facilitated by normalizing each item for some standard year, and in the table shown in the fourth slide, all figures have been compared to their value in 1960, arbitrarily set at 100. In parentheses is the value obtained when constant, rather than current, dollars are used as a basis for comparison. Again two cells are vacant. The FY 1974 values are 333 and 365 respectively for the constant dollar index for academic and medical academic science. A couple of observations are warranted.

- The total budget growth has been paralleled throughout by extramural program growth, and a more or less constant fraction has gone into academic science, at least until about 1972. Since then, the academic sector has borne the brunt of oscillations produced by vagaries in

in research, training and general research support, occasioned by administration proposals and court disposals.

- Over the years, there has been a slight tendency for funds to medical schools to grow more rapidly than the total extramural program or than academic science. Again, the data for the last couple of years reflect a complex and turbulent situation.
- Until recent parlous times, obligations for training grew, but more slowly than extramural program. Clearly, compared to fellowship support, training grants were the more favored instrument for the support of training until the recently enacted legislation governing this activity.
- Extramural research in the form of grants and contracts was the most rapidly growing component of the extramural program throughout the 15 year period under discussion.

Before leaving this slide, I direct your attention once more to the enormous difference, seen in each cell, between the apparent growth, in the upper index value, and the real growth, in parentheses.

You will recall from the first slide that the current dollar expenditures in FY 1975 were estimated to be about double those in FY 1968. The fifth slide, disaggregating in another way and focusing on extramural awards of four different types, reflects this same set of facts. In toto, an increment of between $750-800 million has been added to the obligations of the NIH institutes between FYs 1967 and 1974. Visible in absolute terms on your left but more strikingly so in relative terms on your right, are the facts that:

- Awards for contracts have expanded sharply.
- Awards for program project and center grants have expanded moderately.

- Expansions in activities which connote a high degree of centralized and governmental programming were at the expense of research project grants which connote a high degree of individual investigator initiative.

If disaggregation is carried a step further, additional insight is provided. The sixth slide shows that the bulk of the growth since FY 1968 or more precisely since FY 1971, has been in three of the institutes: NCI, NHLI and NICHD, while the others have expanded only modestly. Indeed, if corrections were made for inflation and for indirect cost increases, the group of institutes on the right hand side would demonstrably have contracted.

The seventh slide indicates that the shift away from regular grants is almost entirely attributable to the actions of the three rapidly growing organizations. Note that the fractional distribution of awards is almost invariate for the more slowly growing institutes on your right, while on the left, the fraction allocated to regular project grants shrank strikingly from FY 1968 to FY 1972.

The eighth slide in this series examines the behavior patterns of each of the three growing institutes over the epoch FY 1967 to FY 1974. In the categories under examination, NCI has grown most rapidly. It has approximately doubled its investments in research project grants and quintupled that in contracts. NHLI has expanded grants by about 30% and like cancer quintupled its investments in contracts.

Against the background data let me return to the matters I mentioned in opening - perspective, data and analysis.

Trends can be identified with certainty only if one examines an extended time series. Major and minor turbulences may characterize a short epoch but only from the long view can one be sure whether a trend had begun or a transient experienced. We are too close to FYS 1972-1975 to distinguish these, and when one is wearing the historian's hat, decision must be deferred.

In contrast to the historian, the activist wants to influence the course of history and is motivated by prior convictions about the direction in which events should be moving. For such individuals, short-term objectives and current data are of overwhelming importance. Budget watching for the activist requires a much more continuing and intense effort. The budgeting process is a long one, confidential within the Federal agencies for about a year until the formal presentation of the Presidents budget each January, and then public until the appropriation act is signed. The process is characterized by the emergence of a number of discrete budgets, including those of the President, the House Appropriations Subcommittee and Committee, the House itself, the Senate Appropriations Subcommittee and Committee, the Senate itself, and the House-Senate Conference Committee. If either body fails to approve the recommendations of Conferrees, recycling in order; if the President fails to sign or vetoes the appropriation bill, recycling again will occur. Thus there are a minimum of four budgets that must be kept in mind each year for those following short term changes.

Those facts bring me to a couple of conclusions, which I offer for your considerations.

- Most of us overreact to one event in a very large trackmeet -- the publication of the President's Budget. This action stimulates knee-jerk

responses all over Washington, with a spate of analyses pouring forth from every quarter. In my view this unduly emphasizes one event and obscures others of at least equivalent import. The President's budget has increasingly become less a rational fiscal plan for Federal expenditures than a strategic and tactical weapon in the President's continuous struggle to impose his will on overall Federal financing. Let me illustrate the transient character, as well as some other properties of the President's budget with the ninth slide. President Ford's recently submitted budget listed the actual FY 1974, the estimated FY 1975 and the proposed FY 1976 obligations for each activity.
The so-called "FY 1974 actual" showed a total of $1,737 million, the estimate for FY 1975 -the current year- was $1,691 and the FY 1976 proposal was for $1,753. The amounts in the document are tabulated in the 1st, 4th and 5th budget entries. What do they say?

- Compared to the FY 1974, - the one rock solid figure now available - the President was estimating that there would be an overall 2.7% decrease this year, followed by a 3.7% increase in the next year. The aggregate small FY 1975 decrease was the resultant of a substantial increase in NCI, stability in NHLI and a substantial decrease in all other institutes. For the following year, the aggregate 3.7% increase was made up of a significant rise in cancer expenditures with modest growth in all other institutes. Thus the formal document submitted to Congress suggested a small reduction in the current year but a modest rise in the upcoming year.
- But where did the President get those figures shown in the 4th budget entry line. In his, or more correctly, Mr. Nixon's, submission a year before a modest aggregate increase had been proposed, as shown by

the second budget entry item, with NCI and NHLI profiting at the expense of the other Institutes. The Congress did not accept the President's recommendation last year, and added large sums to those he proposed, while maintaining the same relative categorical emphasis. Since the recent resolution of a number of issues-such as the AAMC suit on impoundment--there would normally be every expectation that the amounts appropriated would be available for expenditure, and that this appropriation figure, duly signed into law, would become the FY 1975 column of the FY 1976 budget. But Public Law 93-344, recently enacted, and entitled the Congressional Budget and Impoundment Control Act, now permits the President to request Congressional approval to rescind or reserve appropriated funds. Just before the budget was submitted, the President sent a special message to Congress proposing rescissions and, on the assumption that the Congress would approve, used the appropriation revised by rescissions as the basis for the estimate of FY 1975 expenditures in the formal budget message.

- Had the President not taken this course, he would have had to present as the estimate of 1975 expenditures the third entry, the actual appropriation. The impact of that alternative is evident in the last two lines of the table. Instead of being able to claim a modest across-the-board increase, he would have had to admit that his budget proposal was to decrease obligations by 14% in the aggregate and by almost 17% in the less favored Institutes.
- Without making any value judgments, this recital should make clear that the President's Budget is calculated with skill, finesse and artifulness to place in the best of all possible lights the actions

of a President determined to hold down one class of public expenditures. The best possible face has been placed on what might clearly be an unpopular action. A few people may be misled; many will be confused.

- This table also says something about the pace at which data becomes obsolete. The President's Budget message became available about the 1st of February. His rescission message was disapproved by the House on March 8, 1975. By that action, the estimate of FY 1975 expenditures became the congressional appropriation, not the rescission proposal. Thus, within less than six weeks of publication, that part of the President's budget dealing with the increases and decreases in FY 1976 compared to the present year, became obsolete. The parlimentary situation now is that the FY 1976 budget proposes a sharp reduction - about 15% - over a now quite hard estimate of current year expenditures.

Perhaps I have devoted too much attention to this slide, but I wanted to emphasize the difficulties of budget watching for the activists who, not content with observing long-term trends, are concerned with influencing the course of history.

Which brings me to another aspect of budget watching - data acquisition. This is no easy task in the rapidly moving events of any single budget cycle. The data on congressional action is public, if one knows where and when to look for it. Each Federal agency of course tracks the process closely and top level managers are fully aware of the generalities at each step. But even a key Federal official in such an Agency must rely on one or two individuals for absolutely up to date and detailed information about his own Agency, and will often have trouble acquiring data on budgets of other agencies. The NSF budget for instance progresses through a different Congressional

committees than that of the NIH, with hearings, mark-ups, committee reports, floor debates, etc., occurring at variable times. It seems to me that there is a pressing need for a private-sector non-governmental office to collect and maintain data on Federal funding of biomedical research, providing reliable and timely short term as well as historical data in the form of approrpiate publications. The problems of data collection involve more than good leg work. Sophisticated understanding of the organization and programs of the Federal agencies are required to maintain comparability of data over the years when programs are born or die, move to newly created agencies, return to old homes, settle down with the parent organizations in new bureaucratic niches, etc. In addition there are many classification problems-should career awards be assigned to the category "training" or "research"? which must also be resolved. Thus the proposed office would have more than a routine task to carry out.

Why an office outside government? For one reason, no single government agency has all the data readily available. On short notice, I was unable to cover for you today both NIH and NIMH because my contacts at the NIH didn't have reliable NIMH data at their fingertips. For another, Federal agencies are not always either eager or permitted to supply data, especially when there is a reasonable basis to suspect that the information could be used to argue against an administration position.

The final lessons I learned in preparing this talk related to data analysis. Analytical insights come from working over data, and usually require interative processes with new data requirements emerging as new hypotheses are formulated. I had never noticed until looking over data this weekend that the three growing institutes, within an essentially constant total budget, expended less on research project grants and more on research contracts during the period from FY 1967 thru FY 1970. Did their differential behavior during this period provide the

impetus for their subsequent rapid growth? New ideas, - some good some bad - will be the inevitable consequence of collecting and organizing data.

Another facet of the relationship between acquisition and analysis relates to the level of aggregation with which one ought to be content. Even today's once-over-lightly makes clear that important realities are obscured by aggregation and that without detailed data, significant trends can be obscured. NIH, for example, is not a monolith. Clearly, some of its constitutent institutes have experienced quite different histories over the last decade. I suspect that with deeper analysis, each could be shown to be unique in reference to some specific property.

These are subtle problems of analysis which should be mentioned, but for which easy solutions are not available.

- Identical words often are used to describe different concepts. Starting with James A. Shannon, a succession of NIH directors insisted that funds for training be used to develop investigators; if an individual should incidentally receive advanced clinical training for practice, such was regarded as an unwanted but unavoidable secondary effect. In recent years, as training programs came under fire, evidence began to emerge that, to at least some degree, NIH training funds were used for routine residency training. Both NIH staff and university program directors spoke of "training;" each, at least in some instances, attached differing meanings to the word.
- Boundaries of concepts are not clear. What is research? Where does it stop and where does <u>development</u> or <u>patient</u> care begin? To what extent have the very large marginal increases in the expenditures of of the NCI been devoted to research, as that activity is traditionally defined.

- Instruments of support may have assumed unreal properties. How really different is a grant from a contract? When the NCI announces a new instrument of support called a grant, has the leopard changed its spots? Or does a rose under any other name, smell the same? Is creative work possible only under grants? Must contracts be all routine "scut" work.
- Basic perceptions and frameworks for interpretation bias conclusions. Perhaps one of the most interesting sources of noise in the system and divergence among analysts stem from radical differences in the perceptions of individuals of what sort of a system the data describe. The most dramatic example of this in my opinion appeared in Dean Robert Ebert's Presidential address to the Association of American Physicians. Ebert's basic concept of the rational for Federal investments appears, at least to me, to be sharply at variance with the historic positions of the NIH bureaucracy. Nor should there be any mistaking the fact that the long-range future of research may depend heavily on which of these views prevail. The NIH position has long been that there are a host of unsolved problems in the understanding of disease, and that better health for the American people is absolutely contingent upon finding solutions thru research. The NIH budget is designed as a national agenda for research, offered to the President and the Congress as such, and, in the view of the NIH, bought as such by these institutions of government. That the major performers turn out to be medical schools is not the result of deliberate choice, simply the lack of competent competitors. Over time, the fact that so much of the national agenda was executed in academic institutions led to concern for those organizations, not <u>per se</u> but as <u>instruments</u> for both carrying

out the research and for training the manpower to do so in the future. The concern was for universities as <u>means</u>, not <u>ends</u>.

The nation has, it seems to me, given generously to research over the years, recognizing - however dimly - that new knowledge held out the only hope for enhancing the quality and extending the duration of life, and that this new knowledge could be acquired only thru research. Ebert takes a profoundly different view of the basis for Federal research investments in schools of medicine. Implicit in his address is the premise that these funds should support universities as an <u>end</u> not a <u>means</u>. Under such a scheme, the disposition of research funds should be heavily influenced by the faculty of the institution and tailored to fit its educational objectives. The prevailing Federal view and Dean Ebert's could not be more divergent.

There does not seem now to be a clear national consensus on the propriety of Federal aid to medical education. Historically, such assistance has been hard to negotiate, has come into being long after research investments were flourishing and has a fairly uncertain future. Investments in medical schools to carry out a national agenda for research look promising. Investment prospects for other purposes look bleak until the public's quid for its investment quo is more demonstrable qualitatively and quantitatively.

Fundamentally the objective of analysis is to reach a judgment on the value of the several dimensions of the enterprise. And here, we move into an even more complex, controversial and significant era. What do these trends mean? Are they good or bad? For example,

- How much should the nation be spending on biomedical research? Is the present level enough? Is the present growth rate adequate? By what norms and criteria?

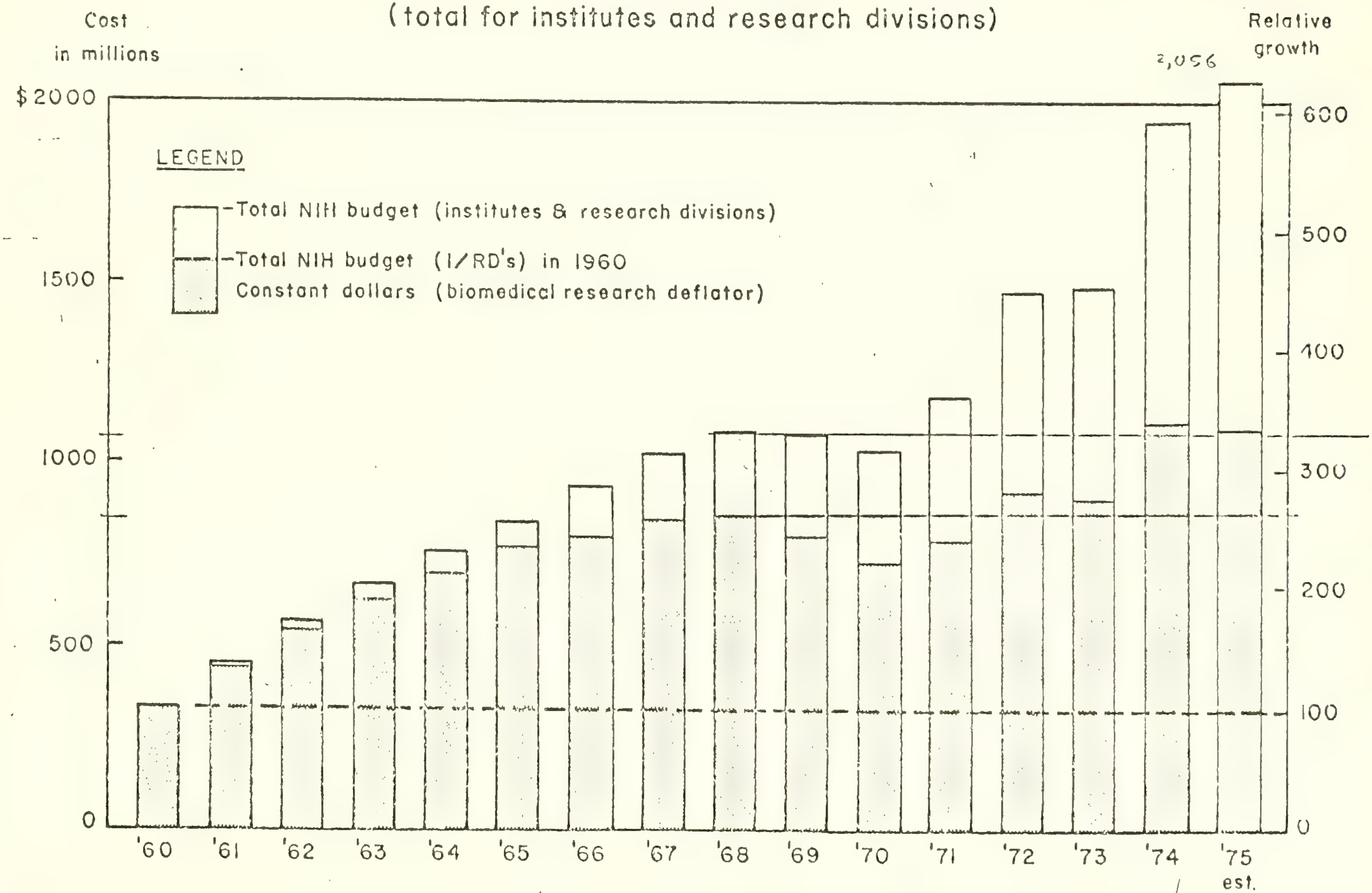
- Is the distribution by category squewed, with too much in pockets such as cancer, heart/lung, population and too little in allergy, arthritis, preclinical sciences? By what criteria should distribution by these categories be determined? Have the categories themselves become outmoded? With what should they be replaced?
- Is applied research and development oversupported? Is the direction in which the NCI, NHLI and NICHD seem to have moved good or bad? Is the national research program relevant to the pressing problems of disease, or not? Can we measure relevance?

It is this set of questions that is at the heart of any exercise to examine trends in the support of biomedical research. We all subscribe to the central dogma that research is an endless frontier. The key question is how can the frontier be advanced most purposefully, broadly and deeply, thru the skillful and intelligent deployment of resources. I could agrue that there are no final answers to most of the most significant questions. The best that can be hoped for is that intelligent and influential people will be able, given suitable data on a timely schedule, to converge on congruent decisions for action. I hope this presentation will have facilitated such a convergence.

(1)

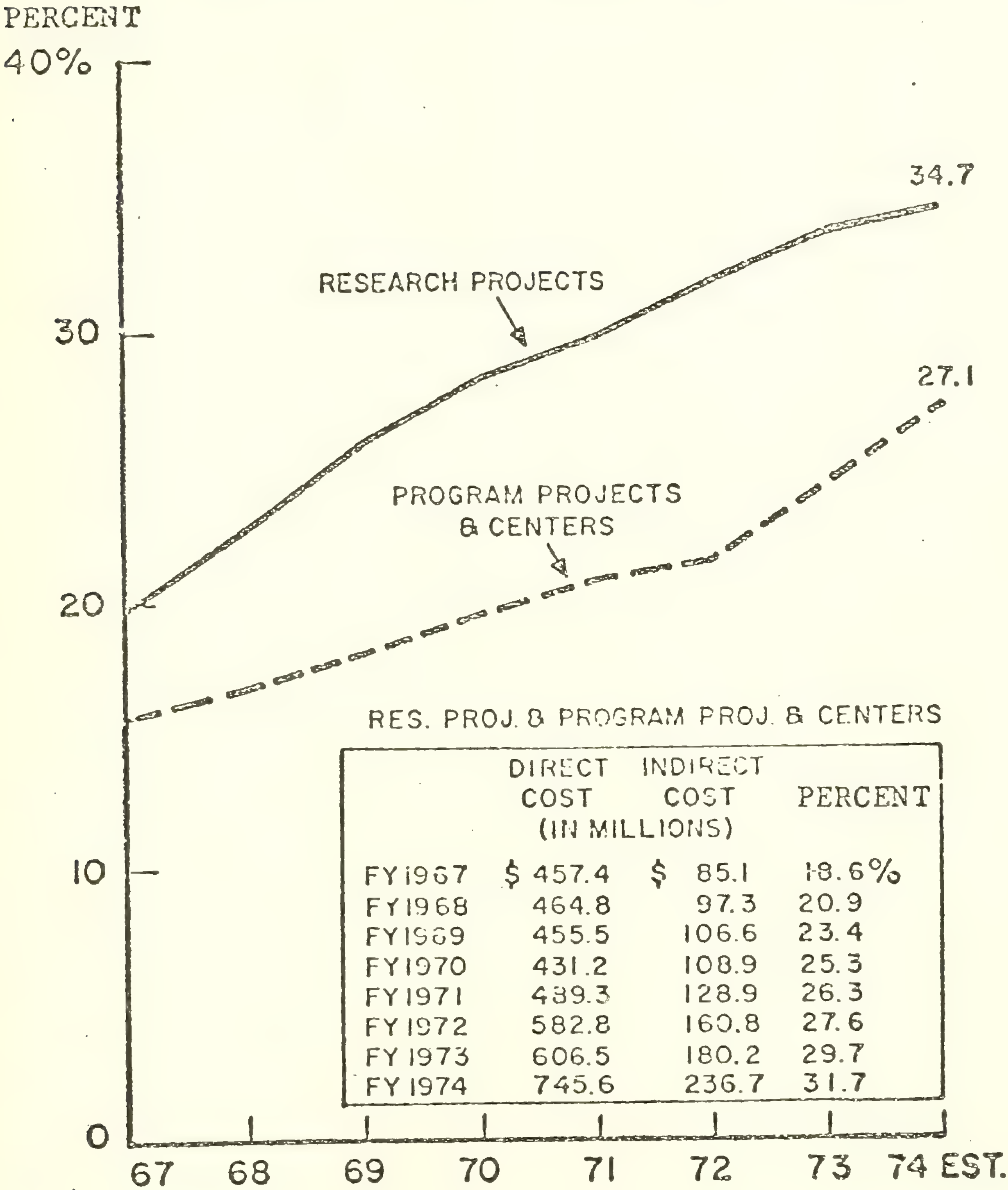
NIH OBLIGATIONS IN CURRENT AND CONSTANT DOLLARS, FY 1960-1975 est.

(total for institutes and research divisions)



2

INDIRECT COST RATES
(PERCENT OF TOTAL DIRECT COSTS AWARDED)



RES. PROJ. & PROGRAM PROJ. & CENTERS

	DIRECT COST (IN MILLIONS)	INDIRECT COST	PERCENT
FY1967	$ 457.4	$ 85.1	18.6%
FY1968	464.8	97.3	20.9
FY1969	455.5	106.6	23.4
FY1970	431.2	108.9	25.3
FY1971	489.3	128.9	26.3
FY1972	582.8	160.8	27.6
FY1973	606.5	180.2	29.7
FY1974	745.6	236.7	31.7

(3)

NIH Obligations for Various Budget Categories, Fiscal Years 1960-1975

(Millions of Dollars)

Budget Category	1960	1965	1970	1975 est.	
Total Budget (I/RD)	$328	$831	$1,030	$2,056	
Total Extramural Programs (I/RD)	280	721	864	1,749	
Total Extramural Research	188	531	713	1,547	
Training Grants	49	106	131	59	
Fellowships	13	20	20	98	
Research Facilities Construction	30	64	--	45	
Total Academic Science (I/RD)	211	554	647	NA	1219(1974)
Total Medical School Academic Science (NIH and NIMH)	145	397	483	NA	913(1974)

(4)

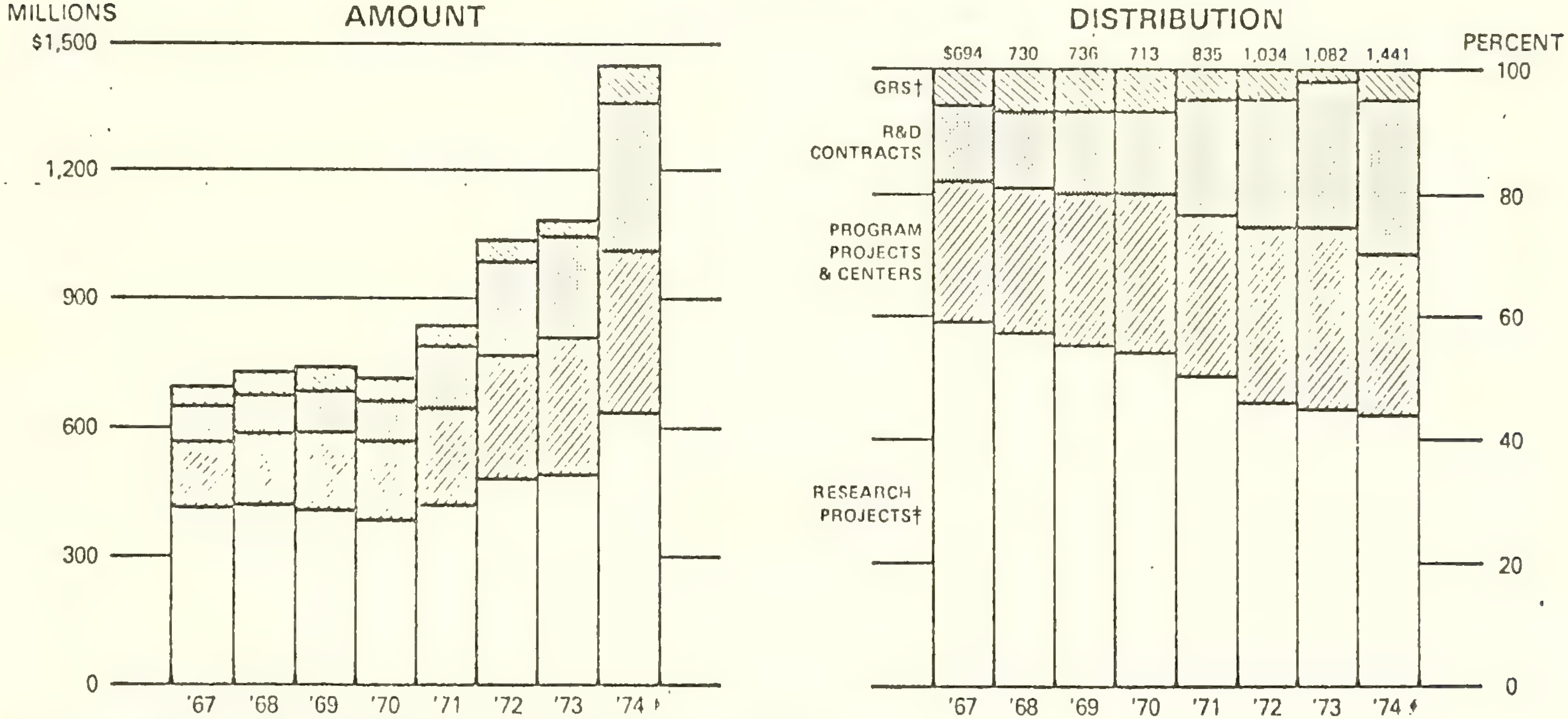
NIH Obligations for Various Budget Categories, Fiscal Years 1960-1975
(In Millions of Current and 1960 Constant Dollars, Normalized to 1960=100)

Budget category	1960	1965	1970	1975 est.
Total Budget (I/RD)	100 (100)	253 (227)	314 (223)	627 (333)
Total Extramural Programs (I/RD)	100 (100)	258 (231)	309 (219)	625 (331)
Total Extramural Research	100 (100)	282 < 230 (254) < 205	379 < 475 (269) < 335	823 < 1760 224 - quts (437) < 635 cont
Training Grants	100 (100)	216 (194)	267 (190)	120 (63)
Fellowships	100 (100)	154 (138)	154 (108)	754 (400)
Total Academic Science (I/RD)	100 (100)	263 (236)	307 (218)	(1974) 575 NA 575 (1974) (333) NA 333 (1974)
Total Medical School Academic Science (NIH and NIMH)	100 (100)	274 (246)	333 (237)	(1974) 630 NA 630 (1974) (365) NA 365 (1974)

(5)

NIH EXTRAMURAL AWARDS FOR R&D AND THEIR PERCENT DISTRIBUTION*

FISCAL YEARS 1967 – 1974



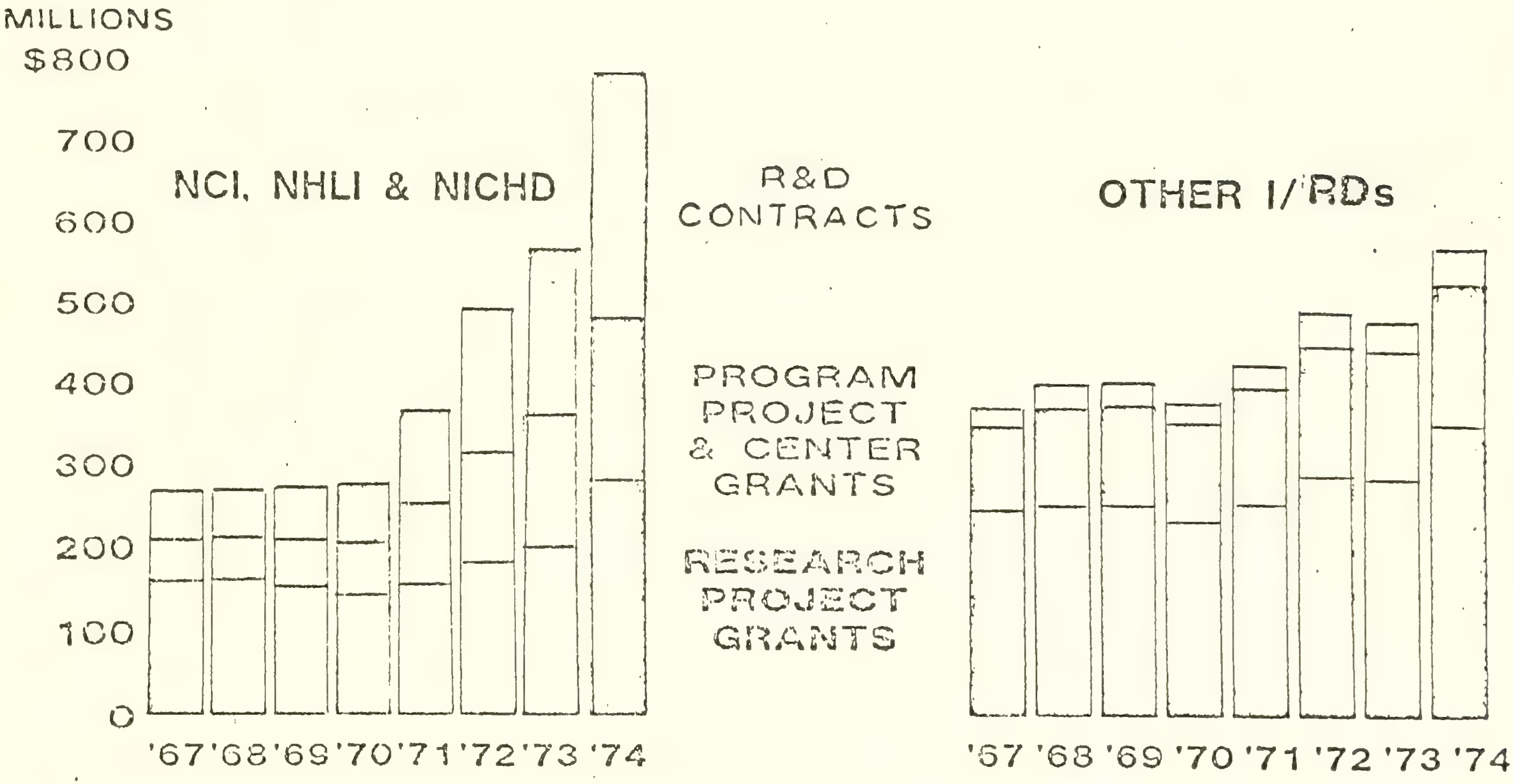
*INCLUDES I/RDs ONLY. †EXCLUDES NIMH PORTION OF GRS PROGRAMS ($8 MILLION IN FY 1974).

‡INCLUDES RCAs ($24 MILLION IN FY 1974). ♯INCLUDES ABOUT $148 MILLION IN FY 1973/74 RELEASED FUNDS.

6

NIH AWARDS BY GROUPED INSTITUTES*

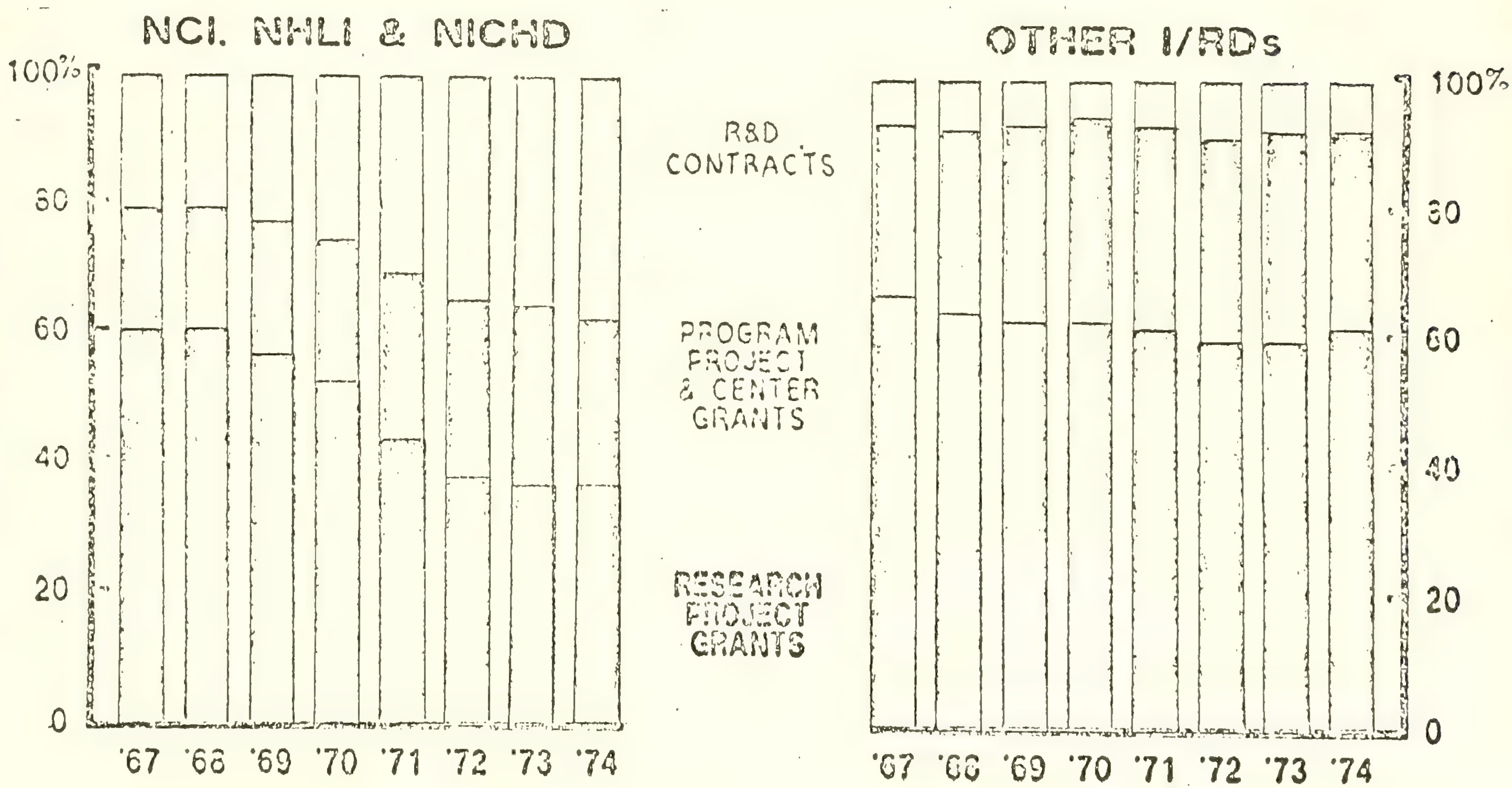
FISCAL YEARS 1967 – 74



*INCLUDES RCA's. EXCLUDES GRS PROGRAMS.
FY 74 INCLUDES FY 73/74 RELEASED FUNDS.

1

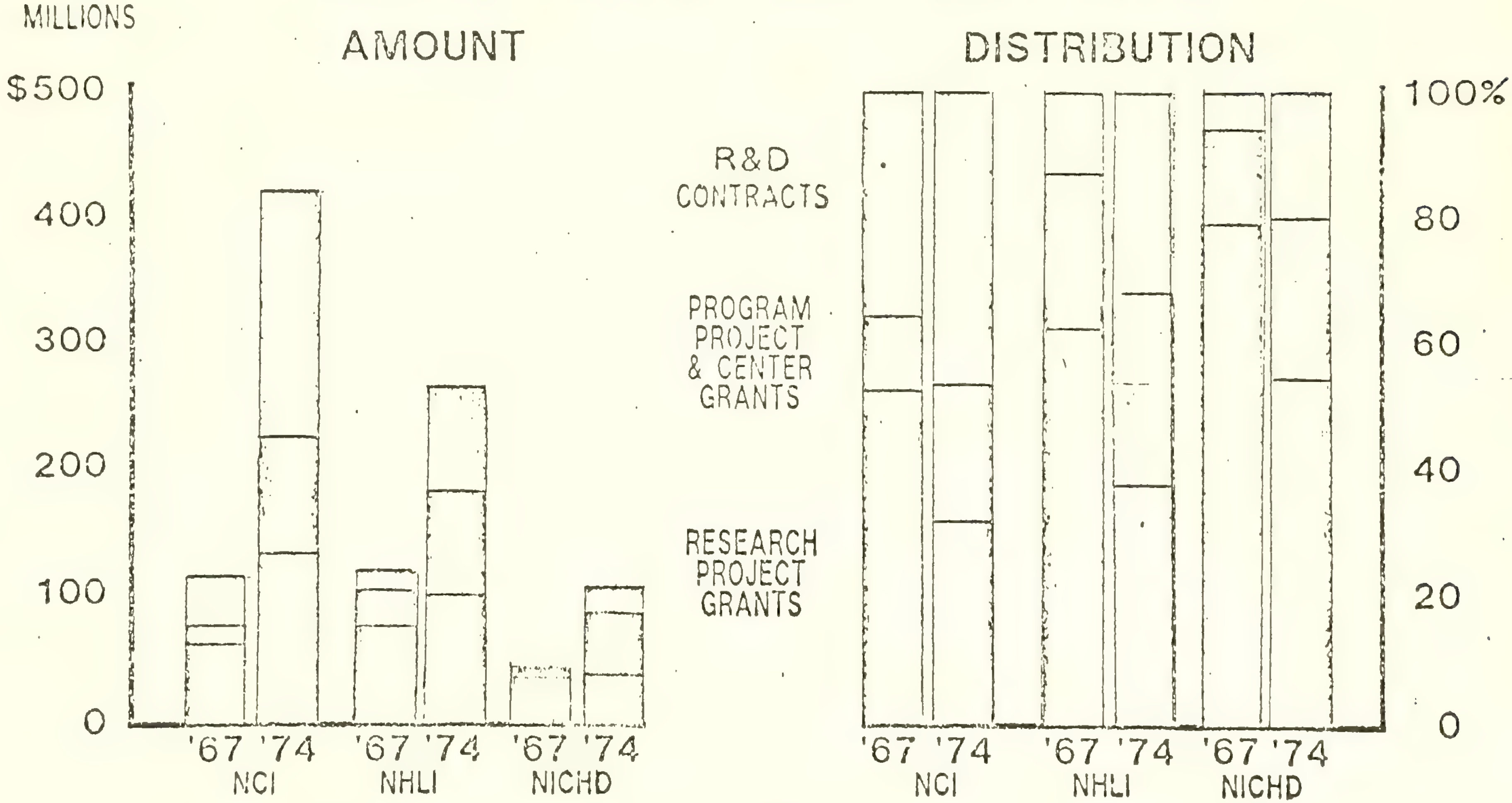
PERCENTAGE DISTRIBUTION OF NIH AWARDS
FISCAL YEARS 1967–1974*



* EXCLUDES GRS PROGRAMS.
FY 1974 INCLUDES 1973/74 RELEASED FUNDS. INCLUDES RCAs.

(8)

AWARDS BY THREE NIH INSTITUTES
FISCAL YEARS 1967 AND 1974*



*FY 1974 INCLUDES FY 1973/74 RELEASED FUNDS. INCLUDES RCA's. EXCLUDES GRS PROGRAMS.

NATIONAL INSTITUTES OF HEALTH (I/RDs)
Relationship of FY 1975 and 1976 Budgets
(Dollars in millions)

	Total I/RD	NCI	NHLI	Other I/RD
1974 available funds	$1,737	$527	$286	$924
1975 President's budget (Jan. 1974)	1,786	600	309	877
Change over 1974	+2.8%	+13.4%	+8.1%	-5.1%
Congressional appropriation (Dec. 1974)	2,042	692	324	1,021
Change over 1974	+17.6%	+31.3%	+13.3%	+11.1%
President's rescission (Dec. 1974)	1,691	569	286	836
Change over 1974	-2.7%	+7.9%	0	-9.5%
1976 President's budget (Jan. 1975)	1,753	605	293	855
Change over 1975 rescission	+3.7%	+6.4%	+2.3%	+2.3%
Change over 1975 appropriation	-14.2%	-12.5%	-9.6%	-16.7%

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